BEHAVIORAL ECONOMICS, NUTRITION EDUCATION, AND ACCESS TO MARKETS: EXPERIMENTAL EVIDENCE AND A THEORETICAL FRAMEWORK FOR IMPROVING DIETARY DIVERSITY

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2017

To women and girls in Bangladesh and all around the world.
“Be who you were created to be, and you will set the world on fire.”
-St. Catherine of Sienna

ACKNOWLEDGMENTS

The proverb “It takes a village” usually references child rearing, yet it rings uncannily true for my journey to doctor. Several people offered support and direction on this dissertation. A multitude of individuals contributed to the research fieldwork. A few significant mentors have shaped my academic pursuits, and I could not have finished this degree without the support of friends and family. I want to express deepest gratitude to my village.

Thank you to my advisor, Dr. Jaclyn Kropp, for the countless hours you have invested in my success. You made me a better researcher. Your dedication and words of encouragement motivated me to finish this dissertation. The process would not have been the same without you and our adventures in Bangladesh. I have gained a true friend and an incredible mentor. Dr. Conner Mullally, thank you for your contributions to this research. I especially appreciate your tolerance of my many questions. Your words of advice often inspired me to believe in myself, and I am grateful for your commitment to my academic development. Dr. Pilar Useche, thank you for sharing your expertise and words of wisdom. Our conversations about development economics ultimately inspired this work.

Several individuals helped bring this project to fruition. The USAID Feed the Future initiative “Integrating Gender and Nutrition within Agricultural Extension Services” (INGENAES) generously funded the research. Dr. Sandra Russo, thank you for investing in my exploration of dissertation topics. You taught me the value of interdisciplinary work. Many thanks to you and Dr. Kathy Colverson for encouraging me to work in Bangladesh and connecting me to INGENAES. Ms. Andrea Bohn, thank you for investing in this project and having confidence in its success. The research would not have been possible without the generous support from our partner agencies, the Bangladesh Agricultural University Extension Center (BAUEC) and Shushilan. I extend a special note of appreciation to the program directors,

coordinating field officers, our study participants, and their families. A few faculty members at BAU were fundamental to the success of this project: Dr. M. Wakilur Rahman, Dr. Md. Salauddin Palash, Ms. Nishith Zahan Tanny, and Mr. Kazi Farid. Thank you for your patience, time, energy, and dedication to the success of this project. Dr. M. Wakilur Rahman, I especially appreciate your contribution – the research would not have been possible without your help.

I had the true pleasure of working with an incredible team of young, motivated master's students from BAU and Patuakhali Technology and Science University (PTSU) during my fieldwork. Thank you for your friendship, hospitality, enthusiasm and time: Sambhu Singha, Shanta Islam, A. M. Shoaib, Shaon Afroz, Tania Akter, Md. Wahidul Islam, Nusrat Farah, Md. Mahmudur Rahman, Md. Azihullah, Afroza Ferdousi, Ayesha Siddika, Sadia Afrin Mumu, Umme Salma Ami, Rubaiya Islam Eva, Rubyeat Hossain, Humayan Ahmed, Sadia Sharmin Hoque, Md. Al-Amin Sheikh, Nazmul Kaysar, Md. Shakir Miah, Anik Roy, Md. Suzauddoula Sharkar, Afia Jahin, Anup Das, Golam Rabbani, Prodip Kumar Poddar, Md. Nosibul Momin, Shatabdi Roy, Nilima Ahmed, Tapoti Biswas, Mahbuba Ferdous, and Shirin Akter.

To our collaborating team at the Bangladesh Institute for ICT Development (BIID), thank you for coordinating the research, my travel, and taking care of many behind-the-scenes tasks about which I will never know. I especially thank Md. Shahid Uddin Akbar and Md. Selim Akbar for your time, hospitality and friendship. Finally, I offer sincerest gratitude to Olyul Islam and Asma Parvin for facilitating over 60 days of participant trainings. Thank you for the sacrifice of time away from your families and for your dedication to the participants. I will always treasure your friendship and the memories we made.

To my Dhaka family, Afrina and Loban, thank you for taking me to Bengali weddings, showing me around the city, and helping me understand cultural barriers. I also appreciate the

cultural advice I received from my fellow graduate student, Marup. Thank you for helping with early translations, teaching me about Bengali markets, and offering project management suggestions.

I have been blessed with amazing friendships and mentors throughout my academic career. I wish to acknowledge a few individuals who have kept me on track. Dr. Rick Weldon, thank you for being my sounding board and reminding me to make time for college sports. Dr. Lisa House, you are an inspiration to women in our field. Dr. Rod Clouser, thank you for your unwavering support. In addition to my fellow Gators, I would be remiss not to thank my University of Kentucky College of Agriculture family. You believed in me and afforded opportunities I thought were far beyond reach. Susan Skees, Jamie Dunn, and Emily Morgan, thank you for fostering my passion for higher education. Dr. Jerry Skees, thank you for introducing me to international development and policy analysis. You inspired me to pursue graduate studies. I've always appreciated your advice and encouragement. Ms. Brenda Oldfield, you helped me get here by investing in me when I needed it the most.

Several friends kept me afloat throughout the dissertation. Yuan, my 'cohort,' we survived! We make a great team. Ricky, thanks for always checking in on me. Joanna, I am so glad we're in this together. I'll miss our coffee and lunch rendezvous. Thank you to the St. A's community, especially Vincent, Gail, Sarah, Mary, Elyssa, and Kim for your prayers. I also extend a special thank you to Fr. David for your prayers, spiritual guidance, and words of encouragement. To Alex and my LIV family, thanks for showing me I'm capable of way more than I think! Amber, thank you for always being the friend I could call when I thought no one else would understand.

Finally, I thank my family. To my mom, Kathy, you inspired me to be a strong, independent woman. You taught me to value education and to dream big. I appreciate all the sacrifices you made. To Kerry, thank you for always reminding me that I was pursuing my passion. You kept my spirits high by sending pictures of the sweetest little boy in the world (my nephew, Ryan). My dad, Rick, taught me to work hard and never give up. It paid off. Thank you for encouraging me to fight for my dreams. My sister Katrina once told me I was smart and I should "be something cool, like a marine biologist" when I grew up. I'm convinced that's why I became an economist. To Koa, my not-so-sweet cat, I apologize for neglecting you these past few years. Thanks for your unconditional cuddles and dissertation supervision. To my in-laws, Bill and Nancy, thank you for your constant support and for raising an incredible son who has seen me through this process. My husband, Kyle, deserves much more praise than I can write. You have shown me the true meaning of love throughout this process. Thank you for your patience while I left you for months at a time to do fieldwork. Thank you for your forgiveness when I often forgot to tell you I'd be working late. Thank you for telling me I wasn't allowed to quit when things got tough. I could not have done this without you.

At the end of the day, my endeavors are all in God's glory. Our Lady of La Leche claimed this dissertation as I defended it on her feast day. She led me on this great journey, facilitating my spiritual and intellectual development in tandem. Thanks be to God for the many blessings He has bestowed upon me and for the fruits that will come from this work.

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LIST OF ABBREVIATIONS

BAU	Bangladesh Agricultural University
BAUEC	Bangladesh Agricultural University Extension Center
BBP	Bengali Portion Plate
BBS	Bangladesh Bureau of Statistics
BCC	Behavior Change Communication
BDT	Bangladesh Taka
BE	Behavioral Economics
FAO	Food and Agriculture Organization
FBDG	Food Based Dietary Guidelines
FCS	Food Consumption Score
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Access Score
IDDS	Individual Dietary Diversity Score
IFAD	International Fund for Agricultural Development
INGENAES	Integrating Gender and Nutrition within Agricultural Extension Services
MaNaR	Managing Natural Resources by the Coastal Community
MDS	Meal Diversity Score
NGO	Non-governmental Organization
RCT	Randomized Controlled Trial
SSC	Staff Selection Commission
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
WFP	World Food Programme

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

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December 2017

Chair: Jaclyn D. Kropp
Major: Food and Resource Economics

More than two billion people worldwide suffer from micronutrient deficiencies, a problem referred to as "hidden hunger." To combat this problem, behavior change communication (BCC) strategies are commonly used in developing countries to change knowledge, beliefs, or values surrounding nutrition. Behavioral economics (BE) is an alternative approach that uses subtle cues to nudge individuals toward healthier food choices. BE strategies are used extensively in the developed world to promote nutrition. However, no study to date has documented the effectiveness of nudges for improving nutrition in development.

This dissertation investigates whether a food-based dietary guidelines (FBDG) nudge, similar to MyPlate, and a BCC strategy in the form of nutrition education can improve nutrition in rural Bangladesh. Research in the US suggests MyPlate nudges are effective at encouraging individuals to consume nutrient-rich foods. In a randomized experiment, we measure the individual and combined treatment effects of the FBDG nudge and nutrition education. To measure the short-term impacts, we observe participants' food choices in a lunch buffet meal where constraints to food access, such as income and availability, are removed. The long-term

effects of the interventions are measured in the home, where constraints to food access are restored, using pre-and post-intervention survey data.

The meal observation results suggest that the FBDG icon alone does not lead to healthier food choices in the short-term; however, combining the FBDG nudge with nutrition education encourages participants to consume a wider variety of foods. Furthermore, repeated exposure to the FBDG icon in the home environment modestly improves the food consumption score, a 7-day measure of dietary variety. Our findings suggest that other factors besides knowledge may constrain household dietary quality.

Hence, we explore the relationships between market participation, production diversity, and household dietary diversity by expanding Barnum and Squire's (1979) agricultural household model to include health, nutrition, and market transaction costs. Empirical analyses suggest a positive correlation between participation in markets for selling products and production diversity, but a negative correlation between participation in markets for selling products and dietary diversity. Thus, household constraints such as market access should be considered in the design of nutrition interventions.

CHAPTER 1
INTRODUCTION

Traditional food security initiatives in low-income countries have improved farm productivity and profitability. As such, the world has seen great technological advances in the production of cereals and grains and an increase in the availability of calories per capita (IFPRI, 2011). However, the persistent prevalence of global hunger, malnutrition, and chronic disease signals that increasing production alone will not solve the food security problem (Thompson and Amoroso, 2011). More than two billion people worldwide suffer from micronutrient deficiencies, a problem referred to as "hidden hunger" (Iannottie et al., 2009; Micronutrient Initiative/World Bank/UNICEF, 2009). In response, international development agencies propose a more comprehensive approach to improving food systems, one which targets not only agricultural productivity but also improves nutrition and health outcomes through nutrition-sensitive agriculture initiatives[1] (IFPRI, 2011; Thompson and Amoroso, 2011; Townsend, 2015; World Bank, 2006). A targeted outcome for many nutrition-sensitive agriculture initiatives is to encourage the consumption of a wider variety of food groups, as consuming a more diverse diet increases nutrient intake and reduces malnutrition (Arimond and Ruel, 2004; Hatloy et al., 1998, Torheim et al., 2004; Ruel and Alderman, 2013).

To facilitate nutrition-sensitive agriculture initiatives, agricultural extension agents or field officers are increasingly tasked with delivering nutrition information alongside technical trainings. As such, there is a growing dialogue about the best practices for communicating nutrition guidelines. Development agencies commonly use behavior change communication (BCC) to promote health and nutrition in developing countries, particularly for child and

[1] Agricultural projects with nutrition-based outcomes are often referred to as nutrition-sensitive agriculture initiatives.

maternal care (Alderman, 2007; Fitzsimons et al., 2016; Haider et al., 2000; Linnemayr and Alderman, 2011; Roy et al., 2007; Wong et al., 2014). BCC encompasses a variety of messaging techniques intended to change knowledge, beliefs, and values in an individual or a community. Examples of BCC include peer counseling or community health worker visits. Behavioral economics (BE) is an alternative approach for health promotion that does not rely on changing the knowledge, beliefs or values of an individual, but rather implements a strategy to discreetly encourage, or 'nudge', the individual to choose a healthier option. In the United States, behavioral economics interventions are increasingly used to promote healthy eating habits (Hanks et al., 2012; Just et al., 2007; Just and Payne, 2009; Miller et al., 2016; Thorndike et al., 2014). However, the application of behavioral economics to nudge nutrition decisions in the developing world is novel, and evidence of its effectiveness has yet to be documented.

In a collection of three essays, this dissertation investigates the extent to which the aforementioned tools for behavior change can influence food choice and explores factors that may constrain dietary diversity among agricultural households. The essays are set in the context of Bangladesh, a country that continues to battle some of the highest rates of malnutrition in the world despite impressive levels of economic growth and poverty reduction (World Bank, 2013). We conducted a randomized controlled trial to measure the potential for BE and BCC strategies to promote diverse, nutrient-rich food choices among men and women in rural Bangladesh. Based on the findings from our experiment, this dissertation also explores the role of income and access constraints on household nutrition decisions.

Our experimental analysis measures the impact of two randomly assigned nutrition interventions: exposure to a plate printed with an icon conveying food-based dietary guidelines (FBDG) and nutrition education in a participatory workshop. The printed plate, which we refer to

as the Bengali Portion Plate (BPP), uses images of food common in the Bengali diet to promote dietary diversity and proper portioning. In its design and intended messaging, the BPP resembles the USDA MyPlate, which is an effective nutrition nudge (Brown et al., 2014; Miller et al., 2016). The nutrition education intervention, on the other hand, exemplifies a strategy for behavior change communication. Participants were randomly assigned to these two interventions, such that some individuals were exposed to the BPP with no nutrition education, some received nutrition education but were not exposed to the BPP, others received both interventions, and those assigned to the control group did not participate in nutrition education and never saw the BPP. Thus, our analysis measures the individual treatment effects of the behavioral economics nutrition nudge and the behavior change communication nutrition education intervention as well as the effects of combining these methods.

To implement the experiment, we invited men and women from agricultural households to the field office of our partnering agency to partake in a lunch buffet. If the participant was assigned to BCC treatment, he or she received nutrition education prior to eating his or her meal. The BPP intervention was introduced during the meal via the plate on which participants served themselves. Participants assigned to the nudge treatment used the BPP and non-treated participants used a regular plate. We collected meal observation data by discreetly recording participants' food choices during the lunch buffet using data collection methods inspired by U.S. research on behavioral economics in nutrition. The meal observation data are analyzed to evaluate the short-term impacts of these interventions on food choices. In addition to analyzing the short-term effects in the lab setting, we also measure the long-term effects of the interventions in the home environment. Each participant who was exposed to the BPP during the buffet meal was given one BPP to take home for each member of his or her family. Thus, we

analyze pre-and post-intervention household survey data to measure the long-term effects of the BPP and nutrition education interventions on dietary diversity at home. By analyzing the meal observation data as well as survey data, we capture both the short-term and long-term effects of a nutrition nudge and nutrition education on individuals' consumption of healthier, more nutrient-rich food items. Furthermore, this unique experimental design allows us to measure the impacts of the two nutrition interventions, both in a lab setting, where the income and access constraints to eating nutrient-rich foods are removed, and also in the home environment, where those constraints are restored.

Chapter 2 presents the short-term, unconstrained effects of the BE and BCC interventions on food choices and meal diversity in the lab setting when income and access constraints are removed. The findings suggest the BPP nudge alone does not affect food choices or increase meal diversity. However, nutrition education and the BPP nudge combined with nutrition education encourage the selection of more diverse foods.

Chapter 3 examines the potential long-term impacts of the BE and BCC interventions by measuring the change in dietary diversity at home. The essay applies a difference-in-difference approach to baseline and endline survey data. The analysis measures changes to individual dietary diversity, controlling for individual, household, and farm characteristics. The baseline survey was conducted at least one day prior to the meal observation, and the endline survey was collected at least one month following the participant's meal observation. In addition to individual dietary diversity over a 24-hour period, we also analyze changes to the food consumption score to assess potential dietary changes over a longer reference period. The results show little to no evidence that either intervention–the BPP nudge or nutrition education–impact

24-hour dietary diversity at home. However, there is evidence that the BPP nudge increases the food consumption score, a 7-day measure of dietary diversity.

Given the weak evidence that theses nutrition interventions produce long-term effects in the home, Chapter 4 investigates the relationship between household dietary diversity and access to markets for buying food and selling agricultural products. Two distinct pathways exist through which changes to agricultural practices, inputs, or the food value chain can lead to improved nutrition (Carletto, 2015; Chung, 2012). Agricultural households that increase their farm production can either use additional income from the sale of these agricultural items to purchase food or they can simply increase consumption by consuming the foods produced on the farm. The latter directly impacts nutrition through food consumption, whereas the pathway to nutrition through the sale of agricultural products assumes that the additional income will be used to purchase nutritious food (Carletto, 2015; Chung, 2012). Chapter 4 investigates whether market participation influences these pathways from agriculture to nutrition, thereby affecting the demand for various nutrients.

Specifically, in Chapter 4, we explore the role of market participation in food production and consumption decisions among our participant households. Our conceptual framework expands Becker's (1965) household production and Barnum and Squire's (1979) agricultural household models to include health, nutrition, and market transaction costs, where production and consumption decisions are nonseparable. Empirical analyses using the baseline survey data examine the relationship between market participation, agricultural production diversity, and household dietary diversity. These analyses provide evidence that the off-farm sale of agricultural products is positively correlated with farm diversity, but inversely related to household dietary diversity.

The findings presented in this dissertation justify further investigation into the use of behavioral economics to improve nutrition in a development context. The novel protocol from our experiment can be extended to other countries to explore the use of behavioral economics to combat malnutrition and hidden hunger. We also recommend further exploration of the constraints that bind household nutrition decisions in developing countries. Potential policy implications of our findings, the limitations of the current study, and an agenda for future research are presented in Chapter 5.

CHAPTER 2
AN EXPERIMENTAL ANALYSIS OF THE IMPACTS OF A BEHAVIORAL NUDGE AND NUTRITION EDUCATION ON MEAL DIVERSITY

Motivation

In South Asia, 336 million people suffer from extreme hunger (World Bank, 2011). However, estimates of food insecurity such as this one do not include micronutrient deficiencies, a problem referred to as "hidden hunger," and hence underreport the true scope of nutrition challenges (Iannottie, 2009; World Bank, 2011). Bangladesh, like many countries in South Asia, has experienced impressive levels of economic growth and poverty reduction, yet it continues to battle some of the highest rates of malnutrition in the world (World Bank, 2013). While the access and affordability of food has increased, a lack of dietary diversity has perpetuated micronutrient deficiencies and hindered progress toward better nutrition. In Bangladesh, rice consumption accounts for more than 70% of daily per capita calorie intake amongst rural households (Ahmed et al., 2013). Economic theory suggests that increases in income would lead to the consumption of a more diverse bundle of foods as households move away from the consumption of staple foods. However, households across Bangladesh consume similar food baskets, with rice being the prominent food item, regardless of income or poverty level (Rabbani, 2014). As a result of limited dietary variety, high rates of vitamin A and iron deficiencies persist (World Bank, 2013).

Improved dietary diversity has been shown to increase nutrient adequacy, thereby reducing the prevalence of stunting and wasting (Arimond and Ruel, 2004; Hatloy et al., 1998; Rah et al., 2010; Torheim et al., 2004). Agencies commonly use behavior change communication (BCC) strategies to promote dietary diversity, particularly among women and children (Alderman, 2007; Fitzsimons et al., 2016; Haider et al., 2000; Linnemayr and Alderman, 2011; Roy et al., 2007). BCC includes various messaging mechanisms intended to change knowledge,

beliefs, or values (e.g. peer counseling, community health visits, etc.). Behavioral economics (BE) is an alternative approach to behavior change that relies on subtle cues to nudge individuals toward healthier choices rather than changing the knowledge, beliefs or values of the individual. In developed countries, behavioral economics interventions such as icons that promote food-based dietary guidelines (FBDG), are used to nudge the consumption of nutrient-rich foods (Hanks et al., 2012; Just et al., 2007; Kongsbak et al., 2016; Miller et al., 2016; Thorndike et al., 2014). However, no study to date has documented the effectiveness of nutrition nudges in the developing world. This essay investigates whether a FBDG icon can nudge individuals in Bangladesh to diversify their diets such that a higher portion of their calories come from nutrient-rich foods instead of rice. In addition, we investigate the impacts of nutrition education as a form of BCC and the effects of combining BCC with a nutrition nudge. Specifically, we estimate the individual and combined treatment effects of two interventions: exposure to a FBDG icon and nutrition education, using regression analysis on meal observation data collected in a cluster-randomized controlled trial experiment.

The FBDG icon in our experiment is a plate designed by the SHIKHA[1] project to promote dietary diversity in Bangladesh. The plate is printed with a pictorial diagram of proper meal portioning and nutrition guidelines. We refer to this plate as the Bengali Portion Plate (BPP). The BPP is similar to the USDA MyPlate in that it uses a simple plate diagram to educate people about the national guidelines for nutrition (USDA, 2016; FHI360/USAID, 2016). Using images of locally prepared food, the BPP portrays information to encourage dietary variety, proper portioning, maternal nutrition, and hand sanitation, while informing users about the types of food that constitute a healthy diet. The key message of the plate is to consume "a half plate of

[1] The SHIKHA project is a USAID initiative facilitated by FHI360 and BRAC to promote dietary diversity and improved nutrition among pregnant and lactating women in Bangladesh

rice and at least four other varieties of food" (FHI360/USAID, 2015). In 2016, the Bangladesh Ministry of Health and Family Welfare formally adopted the BPP for use in their nutrition education efforts targeting pregnant and lactating women (FHI360/USAID, 2016). Although the BPP design targets pregnant and lactating women, the guidelines mirror national dietary recommendations for men and women.

In our experiment, the two interventions were implemented in a lab setting at the field office of our partner agency. The BPP intervention was introduced during a lunch buffet where participants' food choices were discreetly observed, and nutrition education treatments were administered prior to the buffet. This essay analyzes meal observation and survey data to measure the extent to which the interventions encourage men and women in rural Bangladesh to make healthier, more diverse food choices during a buffet meal when food access and income constraints are removed. The results show that the BPP alone has no impact; however, combining the BPP with nutrition education is an effective strategy for encouraging more diverse food choices.

We are specifically interested in whether the BPP can nudge individuals in rural Bangladesh to reduce rice consumption and diversify diets. A nudge is a subtle cue that influences an individual's behavior without removing that individual's freedom of choice (Thaler and Sunstein, 2009). In the case of encouraging better nutrition, a nudge could be the introduction of a nutritional information image like the MyPlate icon, conveniently packaging healthy food items, or changing the choice architecture by arranging food items in a way that encourages the selection of healthier options. In the US, research suggests that the MyPlate icon effectively nudges individuals toward healthy food choices (Brown et al., 2014; Miller et al., 2016). Evaluating the National School Lunch Program (NSLP), Miller et al. (2016) find

elementary and middle school students are 27.7%, 15.8%, and 16.3% more likely to select the fruit, vegetable, and low-fat milk meal components, respectively, when pre-ordering their lunch in the morning using a computer program than when ordering in the normal lunch line. The study shows even larger increases in the likelihood of selecting fruits, vegetables, and low-fat milk of 51.4%, 29.7%, and 37.3%, respectively, when students are prompted with MyPlate messages during the pre-ordering process. Brown et al. (2014) finds similar results–exposing college students to the MyPlate via text message increases the consumption of fruits by 13% and vegetables by 8% compared to the control group. We apply techniques similar to the above-cited literature to test whether participants in Bangladesh can be nudged toward healthier choices to combat malnutrition.

Nudges may be especially effective in the case of preventative care (Banerjee and Duflo, 2011). Some organizations have successfully implemented nudging to promote activities for which households do not receive an immediate reward, but instead receive a future pay off (e.g. bed nets to prevent malaria). Good nutrition is an example of preventative care, as many of the benefits of adopting healthy food choices may only be realized in the future. For example, improving nutrition leads to decreases in child malnutrition, increases in labor productivity, improvements in cognitive development, higher rates of educational attainment, and reduced costs of medical care (Belli et al., 2005).

While several studies have examined the use of behavioral economics in nutrition and food policy in the developed world, the application of behavioral economics to combat malnutrition is just starting to gain traction in low-income economies. The World Bank is currently implementing a set of behavioral economic experiments in Madagascar to nudge women toward purchasing healthier food (World Bank, 2016a). Thus, our experimental design is

novel as it applies methods used in behavioral economics and nutrition research in the US to the context of a developing country. In its unique design, this study develops protocol for future research on nudging nutrition in development. The fusion of behavioral economics with behavior change communication is a unique approach to nutrition interventions in agricultural development. This multifaceted experimental design allows us to evaluate the individual impacts of the BPP nudge and nutrition education, as well as the combined effects. The results from this study will inform agricultural extension providers and community health workers about the best practices for promoting nutrition information using FBDG icons.

The following section provides the details of experimental protocol and meal observation data collection procedures. We then present the empirical model and define the construction of our meal diversity index, which we use to measure the diversity of food choices selected during the buffet meal. Our results are then presented, followed by a discussion of our findings, implications of the findings, and further research.

Experimental Design

To facilitate the recruitment of participants into our field experiment, we partnered with two separate institutions: the Bangladesh Agricultural University (BAU) and Shushilan, a local NGO. The research was conducted in two project areas where the Bangladesh Agricultural University Extension Center (BAUEC) and Shushilan provide agricultural extension services to rural households. For the purpose of this research we engaged Shushilan beneficiaries from the "Managing Natural Resources by the Coastal Community" (MaNaR) project. BAUEC and MaNaR were selected as partner programs based on the criteria that the beneficiaries had not received prior nutrition training. The research was conducted in the Mymensingh and Borguna districts, the beneficiary sites for BAUEC and Shushilan MaNaR, respectively. Mymensingh is located in the northern part of Bangladesh, while Borguna offers a stark contrast in southern

Bangladesh. The BAUEC farmer membership is 55% male and 45% female and spans across 20 unions in one upazila[2]. Membership is open to farmers in the communities surrounding BAU. BAUEC operates as a traditional extension program, disseminating technical agricultural advice for activities such as livestock vaccination. The beneficiary roster for MaNaR is 94% female and 5% male, and the project encompasses three unions in one upazila. Beneficiaries in the MaNaR project were selected on the criteria of extreme poverty and limited access to land or capital. The project promotes production activities such as vegetable multi-cropping and floating gardens, while educating beneficiaries on strategies for climate change resilience. Our target number of participants totaled 1,200 participating in two meal observations each, for a total sample of 2,400 meal observations. Stratifying by location, we targeted 600 randomly selected participants from each district. The sample included 18 communities in the Shushilan project area and 35 communities in the BAUEC project area, where the communities are smaller.

Following a fully factorized randomized controlled trial (RCT) design, participants were randomly assigned to a combination of two interventions: 1) exposure to the BPP and 2) nutrition education. The BPP intervention was introduced as the plate on which participants served themselves during a lunch buffet. The education treatments were implemented through a participatory workshop prior to the lunch buffet. Table 2-1 outlines the possible combinations of the BPP and nutrition education treatment assignments. All participants were invited to two lunch buffet meals, one month apart, where their food choices were discreetly observed. We invited each participant to two meals to observe individual preferences and eating patterns. This was particularly important since the participants were not accustomed to selecting food from a buffet. Individuals assigned to one of the nudge treatments used the BPP during one of the two

[2] An upazila is equivalent to a county-level administrative area; a union is the sub-county level comprised of a cluster of villages

meals, while the control group used a regular plate without the BPP diagram at both meals. We varied the order of exposure to the BPP nudge to test for potential order effects, hence the two-meal design. In the absence of order effects, the observations can be pooled for analysis.

As depicted in Table 2-1, some participants (treatment B) used a regular plate during the first meal observation and the BPP in the second meal observation. Other participants (treatment C) used the BPP in the first meal observation and a regular plate in the second meal observation. The remaining participants (treatment A) used a regular plate for both buffet meal observations and were never exposed to the BPP. Participants in treatment A serve as the control for the BPP intervention. All of the plates used in the experiment, both the regular plate and the BPP, were ordered from the same factory, made of melamine, and equivalent in size. Although the plates have the same background color, the BPP was printed with the proper portioning diagram while the regular plate was printed with flowers (Figure 2-1). The flower print pattern resembles a standard plate commonly used in Bangladesh.

Since this experiment was part of a larger study on the effectiveness of the BPP on dietary diversity, participants assigned to a BPP treatment were also given BPPs to take home. Each participant received one BPP for each family member in his or her household. Researchers distributed these BPPs at the end of the meal in which the treated participant was first exposed to the BPP. To reduce potential spillover effects and contamination that would occur if participants receiving the BPP showed the plate to participants in the control group, the BPP intervention was cluster-randomized at the community level. All participants in a particular community were assigned to the same plate treatment. The nutrition education intervention was randomly assigned at the individual level. In Table 2-1, group 1 serves as the control group. Participants assigned to group 1 were not exposed to the BPP at either meal observation and received no

nutrition education. To satisfy the BCC component of this experiment, each participant was assigned to one of two nutrition education treatments or the control: 1) no nutrition education, “None”, which served as the control, 2) nutrition education, “N”, or 3) nutrition education with an additional gender component, “NG”. Participants received the same BCC assignment, if any, at both meal events.

To implement the experiment, all participants were invited to the field office of their respective partner organization on two occasions, approximately one month apart, for lunch and the nutrition workshop if the participant was assigned to a BCC treatment. Each meal was served at 1:30pm, the typical lunch hour in Bangladesh. Ten food items corresponding to the BPP food groups were arranged in a buffet line: rice (cereals), chicken (meat), fish, mixed vegetables (white potatoes and tubers; orange vegetables), leafy green vegetables, cucumber and onion salad (other vegetables), dal (lentils), boiled eggs, bananas (fruit), and yogurt (dairy). A local chef was hired in each study location. The same chef prepared all dishes in the same fashion, according to local cuisine, for each meal throughout the duration of the study. The items were arranged in the same order in both locations for each meal, and the menu remained the same over the course of the study. Enumerators discreetly observed individuals’ food choices on each occasion as participants served themselves from the lunch buffet. Participants were encouraged to take as much food as they desired.

If the participant was assigned to one of the two nutrition education treatments, he or she attended the respective participatory workshop before the meal. Facilitators who were trained to follow the methods described in the Introductory Workshop on Integrating Gender and Nutrition within Agricultural Extension Services (INGENAES) Facilitator’s Guide by Henderson (2016) conducted the workshops. Specifically, the nutrition education component followed the “What

Goes on the Plate" activity, where small groups illustrated and discussed the components of a healthy diet. The session concluded with a presentation of the national food-based dietary guidelines. The concluding information corresponded to the messages on the BPP; however, the facilitator did not explicitly introduce the BPP during the training. Participants who were assigned to the NG treatment also participated in the "Who Gets What to Eat" exercise from Henderson (2016). The activity facilitated a role-play on intra-household food distribution and invoked discussion on women's nutrition and the cultural norms surrounding intra-household allocation of food. Each participant was assigned the role of a family member in the household (i.e. husband, wife, mother-in-law, son, etc.). The person assigned to the wife role was given a variety of food item props to reflect a household meal. The facilitator then asked the person assigned to the wife role to distribute the food items to the other participants according to their assigned family member roles following social and cultural norms in their community. Once the food had been distributed, the facilitator led participants in a discussion about gender-based dietary needs and the importance of allocating nutrient-rich food, such as protein, among all members of the household.

Individuals assigned to the "N" and "NG" education treatment groups arrived at the research site at 10:00am. All workshop attendees participated in the same nutrition education session, the "What Goes on the Plate" activity. Individuals assigned to treatment "N" received this training only and were then asked to leave the training room for a break. Individuals assigned to treatment "NG" stayed for the gender component of the training. On the day of the workshop, the treatment groups were denoted by colored nametags, prepared in advance by the facilitators. The workshop concluded at approximately 1:00pm. Participants who were assigned to the nutrition education control group, "None", did not receive nutrition training. These

participants were invited to come to the research site at 1:00pm, after the participatory workshop was finished. All participants were invited to eat the buffet meal at 1:30pm, where the BPP experiment was implemented. Individuals received the same assigned education treatment and followed the same schedule for the second meal observation one month later. The nutrition trainings were repeated because frequent exposure to nutrition messages reinforces the information (Brown et al., 2014).

Data Collection

The data collected for this study were gathered through a baseline survey, the field experiment incorporating the two meal observations, and a short post-meal survey following each meal. The baseline survey contained questions on household demographics, agricultural production, household dietary diversity, and prior nutrition knowledge. The survey was conducted as a face-to-face interview at the respondent's home by trained enumerators. All interviews were conducted in Bengali, the national language. Each participant was surveyed at least one business day prior to his or her visit to the field office for the first meal observation. The survey enumerator invited the participant to attend two meals and the nutrition workshops (if applicable) as compensation for his or her time spent completing the survey. The participant was given two meal tickets with the dates, location, and time to arrive at the field office. The meals served as partial compensation for the participant's time, but also provided an opportunity to collect meal observation data. Participants were also given a small monetary stipend, 100 BDT[3] in Borguna and 400 BDT in Mymensingh, to cover their lost wages and transportation costs to the field office at the end of each meal. The respective stipend amounts reflect the differences in local wages and standard rates for research participation across the two districts.

[3] US $1 is approximately 78 BDT

During each meal, enumerators recorded the amount of each food item a person took from the buffet. When the participant had finished eating, enumerators also documented the amount of waste of each food item left on the plate. Selection and plate waste of nine of the ten food items on the lunch buffet were measured using visual inspection. This method of food measurement is frequently used to measure plate waste in school cafeterias and other institutional setting, and has also been used in various nutrition intervention evaluations (Buzby and Guthrie, 2002; Friedman and Hurd-Crixell, 1999). Visual inspection has been validated as a cost-effective, reliable alternative to weighted measurement (Buzby and Guthrie, 2002; Hanks et al., 2014; Richter et al., 2012; Shatenstein et al., 2002).

Our method of visual inspection is an extension of the quarter-waste method, also known as the Comstock method. Under the quarter-waste method, the researcher estimates the proportion of an item's standard serving size that remains on the food tray or plate following consumption. The estimated proportion of a wasted food item is recorded in quarter-increments using a five-point scale (e.g. 0, ¼, ½, ¾, or 1; where 0 indicates that nothing is waste and 1 indicates that the entire serving is wasted) (Buzby and Guthrie, 2002; Comstock et. al., 1981; Hanks et al., 2014; Kropp et al., 2017). The method is typically used in cafeteria settings where portion sizes are standardized; however, Richter et al. (2012) also validated the reliability of visual inspection for nonstandard portions.

Our data collection methods apply the Comstock scale to spoonfuls of the food items selected by the participant rather than standard servings. Since we were interested in selection decisions, we allowed participants to serve themselves from the buffet. Identical serving spoons were used for all food items except the fruit offering (banana), which was measured on a piece-basis. Thus, one spoonful constituted a "standard serving". Data collectors were thoroughly

trained to visually estimate spoonfuls of each item on a five point scale (0, ¼ , ½, ¾, or 1). As is standard practice when applying the Comstock method, all of the data collectors participated in establishing measurement standards. Specifically, the data collectors weighed five spoonfuls of each food item at the beginning of each meal observation day to obtain a baseline measure for comparison. In this process, the researchers agreed on the visual estimation of quarter-spoonfuls for each item, and one researcher recorded the weights of the five standard spoonfuls for each food item. For the analysis, the standardized weight of a spoonful of a food item is calculated as the average weight of a spoonful on the observation day

During the meal, the enumerators recorded the number of spoonfuls of each food item taken by a participant in quarter-increments (0, 0.25, … 1.25, etc.). A zero indicated that the food item was not selected. The method allowed for cases in which the participant took multiple spoonfuls of an item. One of the main intended outcomes of the BPP and nutrition education treatments was to reduce rice consumption. Thus, to get a more precise measurement, rice selection was measured by weight using a hidden food scale placed under the serving dish for rice. Specifically, the platform of the scale was placed under the serving dish and the digital display faced away from the participant. When the participant finished selecting rice, the enumerator recorded the change in weight of the serving dish. The researchers used electronic tablets to record all data for all food items. Selection information was linked to the respective participant using his or her identification number, which was noted on the participant's nametag. To ensure consistency in the visual inspection for each food item, one observer was assigned to record selection of a particular food item. Enumerators remained the same throughout the study period and were thoroughly trained at practice meals to ensure inter-rater reliability.

After the participant finished eating, he or she completed a short post-meal questionnaire about 1) how hungry he or she was before the meal and 2) whether he or she disliked any of the food items on the buffet. At the second meal observation, the post-meal questionnaire also included the four-week household food insecurity questions to account for the fact that more than four weeks had passed since the baseline questionnaire.

Empirical Model

To determine whether these interventions nudge participants toward a more diverse plate of food, we construct an outcome variable to measure participants' meal diversity, which we refer to as the meal diversity score (MDS). The meal diversity score is modeled after the Simpson's index, which is commonly used to measure biodiversity and has also been applied to farm diversity (Jones et al., 2014). MDS is defined as $1-\sum p_{ij}^2$ where p_{ij} is the portion, or share, of the individual's plate allocated to food item *j*. The portion is calculated as $p_{ij}^w = w_{ij} \,/\, W_{ij}$ where w_{ij} is the weight (kg) of food item *j* consumed by the individual, *i*, and W_j is the total weight (kg) all food items ($j=1,2,\ldots,J$) consumed by the individual, such that $W_j = \sum w_{ij}$. As a robustness check we also calculate p_{ij} in terms of the volume of each food item consumed relative to the total volume of food consumed at the meal. This latter measure accounts for the fact that different food offerings have different densities. For example, a quarter of a plate full of boiled eggs weighs more than a quarter of a plate full of rice. To calculate the portion of a food item consumed in terms of volume, $p_{ij}^v = \rho_{ij} / \mathrm{P}_j$ where ρ_{ij} is the volume of a particular item, *j*, consumed by individual *i*, and P_j is the sum of the volume of all food items ($j=1,2,\ldots,J$) consumed by individual *i*, such that $\mathrm{P}_j = \sum \rho_{ij}$. In both cases, the MDS takes a value between

[0,1], where a smaller number represents low meal diversity and a larger number represents high meal diversity.

Prior to regression analysis, we verify the absence of order effects from the two-meal experimental design. We use a paired t-test to determine if the mean difference in MDS_{BPP} (the MDS when a participant is exposed to the BPP) and $MDS_{Regular}$ (the MDS when the same participant is exposed to the regular plate) is statistically significantly different for participants in plate treatment B versus C. If the test indicates that the mean difference is not statistically different by treatment groups, then we can conclude that order effects are not present and the observations from both meals can be pooled. Pooling the meal observations reduces our treatment and control groups to the six combinations presented in Table 2-2.

The following equation represents the model to be used to estimate the impacts of the nutrition education and BPP interventions on the meal diversity score for individual *i* during meal *m* assuming that order effects are not present.

$$MDS_{im} = \beta_0 + \beta_1 BPP + \beta_2 N + \beta_3 NG + \beta_4 BPP \ x \ N + \beta_5 BPP \ x \ NG + X_i' \beta_n + \varepsilon_i \tag{2-1}$$

In Equation (2-1) *BPP* is a dummy variable that takes the value of 1 if the individual was given the BPP to use during the meal observation but received no nutrition education and 0 otherwise. *N* and *NG* are dummy variables indicating whether the individual received nutrition education or nutrition education with a gender component, respectively, but was not exposed to the BPP during the meal observation. The estimated value of β_1 represents the effect of the BPP nudge on *MDS* when the participant is nudged by the BPP alone, β_2 is the impact of nutrition education on *MDS*, and β_3 is the impact of nutrition and gender education on *MDS*. Through interaction terms, β_4 and β_5 measure the combined effects of the BPP nudge with the nutrition or nutrition and gender education, respectively.

The model also includes district-level, household-level, and individual-level explanatory variables contained in X_i. We control for the district where the participant lives using a dummy variable equal to 1 for the Mymensingh district and 0 if the participant lives in the Borguna district. The district covariate captures general differences in socioeconomic status, tastes, and preferences between the two geographical districts. At the household-level we include covariates for household monthly income, a poverty scorecard index, household food insecurity access score (HFIAS), and farm diversity to control for exogenous factors that affect food preferences such as familiarity with various food items. Household monthly income is a continuous variable measured in the local currency, Bangladeshi Taka (BDT). The poverty scorecard index follows Schreiner (2013), taking a value from 0 to 100 to quantify the likelihood that household expenditures are below the national poverty line for Bangladesh. A lower poverty scorecard index represents a higher likelihood that a household falls below the poverty line. The household food insecurity access score (HFIAS) measures participants' perceptions of food vulnerability and responses to food insecurity (Coates et al., 2007). The HFIAS is a continuous variable ranging from 0 to 27, where a higher score represents a higher degree of food insecurity. Farm diversity is a count variable measuring the number of food groups a household produces, where individual crops are classified in food groups following the FAO guidelines for dietary diversity (Kennedy et al., 2010). Studies have shown farm diversity is positively correlated with household dietary diversity (Jones et al., 2014). We expect an individual from a household that produces a larger variety of food may have a higher meal diversity score if he or she is accustomed to eating diverse meals.

Cultural norms such as religion and gender inequities can dictate individuals' consumption of food items. For example, women in Bangladesh generally consume less protein

than men, and traditional hierarchies influence the allocation of food items within the household (Ahmed et al., 2013). Thus, for each individual we also include covariates for religion, sex, age, and relationship to the head of household. Religion is a dummy variable equal to 1 if the participant identifies as Muslim and 0 otherwise. Muslim is the majority religion in Bangladesh. The sex of the individual is a dummy variable equal to 1 if the individual is female and 0 if the participant is male. Age is a continuous variable. The relationship to the head of household is a set of categorical variables for the individual's position in the family, equal to 1 when true and 0 otherwise, where the categories include household head, spouse of household head, and other. Household head is the base category and is omitted from the regression analysis. Education is included as a set of dummy variables where 1 indicates the highest level of education that the individual has completed (none, primary, secondary, junior secondary, SSC pass, or postsecondary) and 0 otherwise, where no education is the omitted category. We expect more educated individuals to be familiar with the health benefits of consuming a variety of food items and be more receptive to the nutrition messages. We also include covariates for baseline nutrition knowledge and hunger at the time of the meal. Nutrition knowledge is a continuous score [0,36] based on responses to a set of questions about dietary recommendations, nutrient content of familiar food items, diet-disease relationships, and child and maternal nutrition. The questions follow the validated methods of Parmenter and Wardle (1999). Hunger at the time of the meal is a Likert scale variable [1,5] ranging from "not hungry at all" to "extremely hungry." Observations about hunger were collected after the participant had finished his or her meal.

In addition to measuring the treatment effects on meal diversity, we also seek to understand how the BPP and nutrition education interventions impact individual consumption behavior for specific food items. Our experimental design provides a unique opportunity to

investigate which types of food items and how much of each food item participants consume, given nutrition information, when income and food access constraints are removed. Thus, in addition to the empirical analysis on meal diversity, we also measure the impacts of the BPP and nutrition education interventions on the consumption of each of the ten food items using linear regressions. The general form of the food item consumption model is:

$$y_{ijm} = \alpha_0 + \alpha_1 BPP + \alpha_2 N + \alpha_3 NG + \alpha_4 BPP * N + \alpha_5 BPP * NG + X_i' \alpha_n + \varepsilon_i \tag{2-2}$$

where y_{ijm} is the amount (kg) of food item *j* consumed by individual *i* during meal *m*. The treatment variables and covariates are the same as defined in Equation (2-1). Thus, the estimated value of α_1 represents the effect of the BPP nudge on the consumption of food item *j* when the participant is nudged by the plate alone, α_2 is the impact of nutrition education, *N*, on the consumption of food item *j*, and α_3 is the effect of nutrition education with a gender component, *NG*, on the consumption of food item *j*. The combined effects of the BPP nudge with *N* and *NG* are measured through the estimated values of the coefficients on the interaction terms, α_4 and α_5, respectively.

We hypothesize that the BPP will be most effective at improving meal diversity when combined with nutrition education. We also estimate the impact of adding a gender component to the training, which we expect will have a larger impact on MDS than nutrition education alone, since basic dietary recommendations are reiterated during the discussion about intra-household allocation of food. We expect participants in the BPP treatment group will consume more nutritious food items and less rice than the participants who were not exposed to the plate. Following our hypotheses on meal diversity, we also expect the impact on the consumption of nutritious food items to be largest when the plate is combined with nutrition or nutrition and gender education.

The models are estimated using OLS regression. Due to the cluster-randomized design, we cluster our standard errors at the community level. However, clustered standard errors may result in downward biased estimates and over-rejection of the null if the number of clusters is small (Cameron and Miller, 2014; Cameron et al., 2008; Duflo et al., 2008; Wooldridge, 2004). With 53 unbalanced clusters divided into five treatments and the control, we have potentially too few clusters. Following Mackinnon and Webb (2017) we estimate wild cluster bootstrap-t p-values to correctly test our hypotheses given the few clusters problem.

Results

Table 2-3 presents the descriptive statistics for all participants by district. Our sample includes 1,105 individuals in the first meal, 1,077 of whom returned for meal two, for a total of 2,182 meal observations. Thus, the attrition rate was approximately 2.5%. We use a balanced sample of 2,227 observations in all estimation results. The Mymensingh district is slightly overrepresented with 54% of participants residing in this district. Our sample is 70% female, primarily due to the woman-centric nature of the Shushilan MaNaR project. When possible, we recruited male members of the Shushilan beneficiary households. The mean household income is 11,001 BDT, or approximately USD $140, per month. Following the estimates of household poverty likelihoods in Schreiner (2013), the mean poverty score of 49 implies that 33.5% of the sample lives on less than USD $1.25 per day. Participants from the Borguna district have a higher mean poverty score and higher mean HFIAS than participants in Mymensingh. Thirty-six percent of participants have no formal education. This is not surprising since we recruited participants through organizations who serve rural households. On average, the households in our sample produce 3.4 different food groups. To account for spiritual norms surrounding food consumption, we also asked participants to identify the religious affiliation of their household. The majority of households in Bangladesh identify as Muslim, which is reflected in our sample.

On a scale of 36, the average nutrition knowledge score is 18.9, just over 50%. This confirms that our sample had a low comprehension of nutrition recommendations prior to the field experiment. Tables A-1 through A-4 in Appendix A present further analyses of summary statistics for individual and household characteristics by treatment group. Table A-4 also contains Pearson's Chi-squared statistics, which test the differences in covariate distribution between treatment groups.

Table 2-4 shows mean consumption (kg) of each of the ten food items per meal. As one would expect according to the traditional Bengali diet, rice is the most consumed food item. On average, participants consumed 0.38 kg of rice per meal. This is consistent with the amount of rice one would expect participants to consume if the lunch buffet is the primary source of food for the day. The average daily per capita rice consumption in Bangladesh is 495.5 grams, or 0.495 kg (Ahmed et al., 2013). Since we informed participants at least one day prior that a meal would be served at the event, we expected the participants would consider the lunch buffet as their primary source of calories for the day. As noted in the methodology section, our model controls for the individual's level of hunger at the time of the meal. Table 2-3 shows the average hunger score was 3.7, or "very hungry". By design, this field experiment removes income and access constraints to nutritious food items such as meat and dairy, which may be too expensive for many of the participants to purchase for home consumption. It is not surprising then, that the mean consumption of protein sources, chicken, fish, yogurt, and lentils, are also relatively high. The average meal diversity score, MDS, is 0.77, which indicates that participants consumed relatively diverse meals at the experiment. Participants consumed 7.8 different food items on average.

We conduct a cluster-adjusted paired t-test to verify the absence of order effects. The t-test is clustered since BPP treatment was cluster-randomized at the community level. The clustered t-test results confirm that the mean difference in MDS_{BPP} and $MDS_{Regular}$ is not statistically significantly different for participants in plate treatments B versus C (p = 0.179; Table A-6). Thus, we determine no order effects exist, and we analyze the pooled meal observation data.

Table 2-5 presents the results of the regression analyses on the meal diversity score by weight. The table reports standard errors clustered by community as well as wild-cluster bootstrap-t p-values. The coefficients on the education treatment variables, *N* and *NG*, as well as the interaction between the BPP treatment and nutrition education, *BPP x N*, are positive and statistically significant. These results suggest the individuals who received nutrition education (*N*) consumed a larger variety of food items than participants that did not receive nutrition education and were not exposed to the BPP. The MDS was 0.016 higher on average for this group, a 2.1% increase on the mean. The MDS for participants in the *NG* treatment was 0.017 higher on average than participants that did not receive the education treatment and were not exposed to the BPP. Although the treatment effect of the combined nutrition and gender (*NG*) education is larger in magnitude than the effect of nutrition education alone (*N),* a Wald test on the two parameters shows there is no statistically significant difference in the coefficients (p = 0.4371).

Confirming our hypothesis, the largest treatment effect comes from the combination of the “what goes on the plate” activity in the nutrition workshop and exposure to the BPP. Individuals received nutrition education and were also exposed to the BPP during the lunch buffet consumed a more diverse meal on average than the participants in the control group. On

average their MDS were 0.02 points higher, a 2.6% increase on the mean. However, the estimated coefficient on the interaction between exposure to the BPP and the combined trainings on nutrition and gender, *BPP x NG*, is not statistically significant. This is likely due to the baseline level of nutrition knowledge of participants in the *NG* treatment group. Although the interventions were randomly assigned, the group assigned to nutrition and gender training had a higher baseline understanding about nutrition according to the nutrition knowledge assessment scores. A Pearson's chi-squared test confirmed the statistically significant difference in nutrition knowledge between nutrition education treatment groups. Thus, the effect of prior nutrition knowledge of these participants captured in the nutrition knowledge assessment scores potentially dampened the effect of the effect of *BPP x NG*, rendering it insignificant.

While the effects of the nutrition education treatments fit our hypothesis, the BPP alone did not statistically significantly impact meal diversity. We suspect the plate alone is not effective because the key messages on the plate are written in Bengali (Figure 2-1). While we did not measure participant literacy directly, our sample is largely uneducated and hence likely illiterate. Therefore, it is reasonable to assume participants who have had no formal education or only completed primary school are unable to interpret the written messages on the BPP. The food images on the BPP were not sufficient to nudge individuals toward more diverse food choices. However, when the key messages were verbally communicated during the participatory training on nutrition, the plate nudged participants to consume a more diverse meal.

While the results of the paired t-tests imply that order of exposure to the BPP did not affect the plate's impact on MDS, we repeat the regression analysis with the inclusion of a dummy variable indicating the participant was exposed to the BPP at the second meal as a robustness check. Model 3 in Table 2-5 shows the indicator variable for order of exposure is not

statistically significant, verifying the results of the paired tests. Thus, we confirm no order effects exist.

Table 2-6 presents the regression results when MDS is constructed based on the relative volume of each food item consumed to the total volume of food consumed. The results are similar in magnitude and statistical significance, verifying the robustness of our model.

At the aggregate level, we are interested whether participants consume a more diverse set of foods given nutrition information. However, this study also employs a unique approach to understand consumption behavior with respect to specific food items. The increase in meal diversity may be driven by a preference for certain nutrients or food items. Thus, in addition to the analysis on meal diversity, we also evaluate the treatment effects on the consumption of each of the ten food items. Table 2-7 presents these regression results, and Table 2-8 presents the regression results with covariates. Contrary to our hypothesis, the results show no statistically significant treatment effects on rice consumption. The consumption of lentils (dal) is 0.014 kg higher on average among individuals who were assigned to the nutrition education treatment and 0.016 kg higher on average for participants who received nutrition education with the gender component, compared to those who did not receive nutrition or gender education and were not exposed to the BBP. Additionally, participants who used the BPP and received nutrition education, with or without the gender component, consumed more lentils on average compared to the control group, 0.029 kg and 0.020 kg, respectively. Furthermore, the average consumption of leafy green vegetables is slightly higher, 0.005 kg, for participants who received education treatments compared to those who did not receive nutrition or nutrition and gender education and were not exposed to the BPP. There is no statistically significant effect, however, on the

consumption of leafy green vegetables when the trainings are combined with the BPP intervention.

The results of the regressions on specific food items suggest that the treatment effects on meal diversity may be driven by lentil consumption. This may be due to the pronounced image of lentils on the BPP. Alternatively, it is also possible that our participants were more familiar with lentils as a source of protein compared to other food items, as lentils are a more affordable source of protein and hence might be consumed in the home more frequently than other protein sources.

Conclusion

Several development initiatives aim to promote nutrition among agricultural households in Bangladesh and the greater South Asia region. Food-based diagrams and food plate tools are especially popular instruments to communicate nutrition information. In certain cases, these tools can be used to nudge individuals toward healthier food choices as recent studies have shown their effectiveness in the US (Brown et al., 2014; Miller et al., 2016). However, initiatives for communicating any type of behavior change can be costly in developing countries. For an initiative to be successful, it is critical that the characteristics of the target population be taken into account in the design and implementation of behavioral change strategies. Furthermore, evidence-based pilot testing and impact evaluation should be implemented prior to scaling up the initiative.

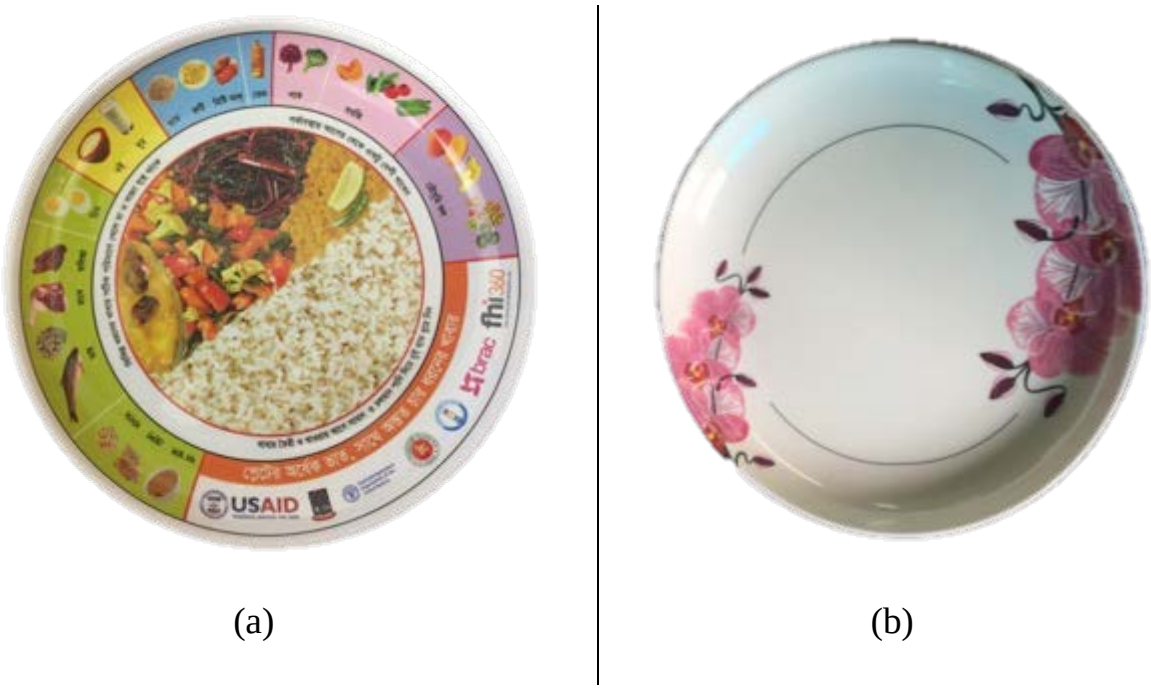
In this study we conducted an experiment using meal observation data to measure the impacts of a melamine plate printed with Bengali food-based dietary guidelines on food choice and meal diversity. In addition to the BPP, a behavioral nudge, our study measured the effects of behavior change communication through participatory education on nutrition and gender norms surrounding nutrition. The results of this randomized controlled trial show that exposure to the

printed BPP alone is not enough to encourage individuals to consume a more diverse diet. However, when the BPP is combined with nutrition education, individuals consume a more diverse meal. In Bangladesh, nutrition guidelines especially emphasize a reduction in rice consumption. Thus, we also used the meal observation data to test the effect of the BPP and education interventions on rice consumption as well as the consumption of other food items. We found the interventions are not successful at decreasing rice consumption.

A caveat to this research is that our sample is a subset of the membership rosters for our partner organizations. A nationally representative sample would allow for a more robust analysis of the treatment effects to better inform the scale-up ability of the tested interventions. Furthermore, the pre-existing relationship between participants and the respective partner organization may influence these results. Participants are potentially more receptive to the information treatment due to their relationship with and trust in the partner organization. The fact that participants were compensated to complete the study also generates potential bias in choices, as the level of compensation might bias the extent to which they internalize the program information. Further research should explore the role of trust in nutrition information dissemination.

This study employed a novel approach to evaluating nutrition-sensitive initiatives in agricultural development. Drawing upon research from the developed world, this randomized controlled trial used meal observation data collection methods to investigate the use of behavioral economics strategies for improved nutrition in developing countries. The methods used in this study can be extended to other countries to evaluate similar strategies for nudging individuals to improve nutrition and dietary diversity.

In addition to research protocol, this study offers direct policy implications. Several organizations in Bangladesh plan to use the BPP in their nutrition programs, some of which emphasize agricultural interventions (FHI360/USAID, 2016). Thus, this study specifically targeted households in rural Bangladesh to evaluate the effectiveness of the BPP as a tool for improving dietary diversity in agricultural communities. Low levels of education characterize our target population. Assuming education is a proxy for literacy, we suspect low literacy levels in our sample influence our findings, which show that the BPP is not an effective nudge toward dietary diversity. The key messages on the BPP are written in Bengali, thus the information might not be conveyed to illiterate participants unless it is verbally communicated. The findings suggest participatory training at the community-level is an effective approach to communicating information where literacy is a constraint. Thus, we encourage policy makers to consider the appropriateness of nutrition training tools for the education level and literacy of the target population. Further research is necessary to determine if the results would differ if participants had a higher rate of literacy. The evidence-based results from this field experiment inform government and non-government agencies in Bangladesh about the effectiveness of the BPP. Agencies in other developing countries can replicate the methods used in this study to pilot-test similar nutrition interventions.



(a) (b)

Figure 2-1. Bengali Portion Plate and regular plate used in the plate intervention
Messages: “Half plate of rice and at least four other varieties of food”, “Eating a variety of food in appropriate amounts keeps mothers and children healthy”, “Eat a little more food during pregnancy” and “Wash both hands and soap with running water before preparing and eating food.”
Source: FHI360/USAID SHIKHA Food Plate (Bengali Portion Plate)

Table 2-1. Experimental design: treatment groups

Behavioral Economics Intervention	Behavior Change Communication Intervention		
Treatment (Meal 1, Meal 2)	No Nutrition Education	Nutrition Education	Nutrition and Gender Education
Treatment A (Regular, Regular)	Group 1	Group 2	Group 3
Treatment B (Regular, BPP)	Group 4	Group 5	Group 6
Treatment C (BPP, Regular)	Group 7	Group 8	Group 9

Table 2-2. Empirical analysis: treatment groups and indicator variables by intervention

Behavioral Economics Intervention	Behavior Change Communication Intervention		
	No Nutrition Education	Nutrition Education	Nutrition and Gender Education
Regular plate	(Control)	*N*	*NG*
BPP	BPP	BPP x *N*	BPP x *NG*

Table 2-3. Descriptive statistics: covariates

	All		Borguna		Mymensingh	
VARIABLES	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Nutrition education	0.23	0.42	0.22	0.415	0.23	0.42
Nutrition and gender education	0.22	0.41	0.22	0.413	0.22	0.42
BPP only	0.11	0.31	0.12	0.319	0.10	0.30
BPP x nutrition education	0.13	0.33	0.13	0.337	0.12	0.33
BPP x nutrition and gender education	0.12	0.32	0.12	0.322	0.11	0.32
Mymensingh district	0.54	0.50				
Household monthly income (BDT)	11001.44	9466.80	6159.34	4885.36	15130.50	10425.22
Poverty score [0,100]	48.59	16.00	38.27	11.04	57.42	14.20
Number of food groups produced [0,12]	3.40	2.23	2.16	1.83	4.47	1.98
Household food insecurity access score [0,27]	1.92	3.68	3.53	4.40	0.53	2.09
Religion (Muslim = 1)	0.95	0.21	0.91	0.28	0.99	0.11
Female	0.70	0.46	0.92	0.27	0.52	0.50
Age	38.03	12.50	38.54	11.67	37.59	13.17
Primary school (highest level)	0.33	0.47	0.44	0.50	0.24	0.43
Junior secondary school (highest level)	0.11	0.31	0.06	0.24	0.15	0.36
Secondary school (highest level)	0.06	0.24	0.02	0.14	0.10	0.30
SSC pass (highest level)	0.06	0.23	0.01	0.08	0.10	0.30
Postsecondary school (highest level)	0.07	0.25	0.00	0.06	0.12	0.33
Spouse of household head	0.51	0.50	0.66	0.47	0.39	0.49
Other relationship to household head	0.13	0.33	0.06	0.23	0.19	0.39
Hunger at time of meal event [1,5]	3.71	1.17	3.13	1.16	4.21	0.93
Baseline nutrition knowledge score [0,36]	18.86	5.10	17.38	5.23	20.12	4.63

N = 2,227

Table 2-4. Mean consumption of food items and diversity score

Dependent variable	Mean	St. dev.
Rice (kg)	0.38	0.17
Chicken (kg)	0.08	0.04
Fish (kg)	0.08	0.04
Salad (kg)	0.05	0.05
Egg (kg)	0.06	0.02
Mixed vegetables (kg)	0.07	0.05
Leafy green vegetables (kg)	0.05	0.04
Lentils (dal) (kg)	0.09	0.09
Fruit (banana) (kg)	0.07	0.05
Yogurt (kg)	0.08	0.06
Meal diversity score by weight [0,1]	0.77	0.08
Meal diversity score by volume [0,1]	0.75	0.08
Number of food items consumed [0,10]	7.80	1.54

N = 2,227

Table 2-5. Treatment effects on meal diversity score by weight

VARIABLES	(1) MDS (weight)	(2) MDS (weight)	(3) MDS (weight)
Nutrition education	0.016***	0.013***	0.013***
	[0.005]	[0.005]	[0.005]
	p<0.001	<0.014>	<0.020>
Nutrition and gender education	0.017***	0.016***	0.016***
	[0.005]	[0.005]	[0.005]
	<0.002>	<0.006>	<0.004>
BPP intervention	-0.001	-0.004	-0.005
	[0.010]	[0.007]	[0.007]
	<0.932>	<0.616>	<0.462>
BPP x nutrition education	0.020*	0.016*	0.014*
	[0.010]	[0.008]	[0.008]
	<0.076>	<0.054>	<0.098>
BPP x nutrition and gender education	0.010	0.007	0.006
	[0.010]	[0.007]	[0.007]
	<0.312>	<0.276>	<0.350>
Mymensingh district		0.045***	0.045***
		[0.009]	[0.009]
		<0.002>	p<0.001
Household monthly income		-2.94E-07	-3.06E-07*
		[1.54E-07]	[1.58E-07]
		<0.078>	<0.104>
Poverty score		1.66E-04	1.66E-04
		[1.44E-04]	[1.44E-04]
		<0.252>	<0.284>
Number of food groups produced		0.001	0.001
		[0.001]	[0.001]
		<0.648>	<0.674>
Household food insecurity access score		2.07E-04	2.23E-04
		[0.001]	[0.001]
		<0.694>	<0.648>
Religion (Muslim / non-Muslim)		0.070***	0.069***
		[0.019]	[0.019]
		<0.048>	<0.052>
Female		-0.006	-0.006
		[0.006]	[0.006]
		<0.334>	<0.330>
Age		-1.35E-04	-1.38E-04
		[1.56E-04]	[1.57E-04]
		<0.402>	<0.394>

Table 2-5. Continued.

VARIABLES	(1) MDS (weight)	(2) MDS (weight)	(3) MDS (weight)
Primary school (highest level)		0.006	0.006
		[0.004]	[0.004]
		<0.166>	<0.168>
Junior secondary school (highest level)		-0.002	-0.002
		[0.005]	[0.005]
		<0.718>	<0.696>
Secondary school (highest level)		0.017***	0.017***
		[0.006]	[0.006]
		<0.012>	<0.012>
SSC pass (highest level)		0.012*	0.012*
		[0.007]	[0.007]
		<0.102>	<0.074>
Postsecondary education		0.017**	0.017**
		[0.008]	[0.008]
		<0.052>	<0.040>
Spouse of household head		-0.002	-0.002
		[0.006]	[0.006]
		<0.732>	<0.666>
Other relationship to household head		-0.001	-0.002
		[0.006]	[0.006]
		<0.866>	<0.830>
Hunger at time of meal event		0.003	0.003
		[0.002]	[0.002]
		<0.210>	<0.214>
Baseline nutrition knowledge		4.00E-04	3.97E-04
		[3.59E-04]	[3.60E-04]
		<0.268>	<0.290>
Order effect (BPP in first meal)			0.004
			[0.006]
			<0.472>
Constant	0.764***	0.658***	0.658***
	[0.008]	[0.023]	[0.023]
Number of observations	2,227	2,137	2,137
R-squared	0.010	0.214	0.214

Robust standard errors in brackets; Wild cluster bootstrap-t p-value in <>*** p<0.01, ** p<0.05, * p<0.1

Table 2-6. Treatment effects on meal diversity score by volume

VARIABLES	(1) MDS (volume)	(2) MDS (volume)	(3) MDS (volume)
Nutrition education	0.012**	0.008	0.008*
	[0.006]	[0.005]	[0.005]
	<0.044>	<0.110>	<0.090>
Nutrition and gender education	0.014**	0.013**	0.014**
	[0.006]	[0.006]	[0.006]
	<0.018>	<0.032>	<0.042>
BPP intervention	-3.62E-04	-0.006	-0.005
	[0.010]	[0.008]	[0.008]
	<0.954>	<0.414>	<0.450>
BPP x nutrition education	0.023***	0.016**	0.017**
	[0.008]	[0.008]	[0.008]
	<0.010>	<0.062>	<0.042>
BPP x nutrition and gender education	0.015*	0.010	0.011
	[0.008]	[0.007]	[0.007]
	<0.082>	<0.148>	<0.140>
Mymensingh district		0.014*	0.014*
		[0.008]	[0.008]
		<0.082>	<0.094>
Household monthly income		-4.58E-08	-3.62E-08
		[1.98E-07]	[1.94E-07]
		<0.804>	<0.862>
Poverty score		1.96E-04	1.97E-04
		[1.67E-04]	[1.68E-04]
		<0.260>	<0.262>
Number of food groups produced		-0.001	0.00E+00
		[0.001]	[0.001]
		<0.602>	<0.640>
Household food insecurity access score		3.18E-04	3.02E-04
		[0.001]	[0.001]
		<0.562>	<0.572>
Religion (Muslim / non-Muslim)		0.076***	0.077***
		[0.015]	[0.015]
		<0.016>	<0.001>
Female		-0.008	-0.008
		[0.007]	[0.007]
		<0.246>	<0.228>
Age		4.35E-05	4.63E-05
		[1.64E-04]	[1.62E-04]
		<0.776>	<0.790>

Table 2-6. Continued.

VARIABLES	(1) MDS (volume)	(2) MDS (volume)	(3) MDS (volume)
Primary school (highest level)		0.005	0.005
		[0.005]	[0.005]
		<0.316>	<0.300>
Junior secondary school (highest level)		-0.002	-0.002
		[0.006]	[0.006]
		<0.700>	<0.704>
Secondary school (highest level)		0.021***	0.021***
		[0.006]	[0.006]
		<0.040>	p<0.001
SSC pass (highest level)		0.008	0.008
		[0.007]	[0.007]
		<0.262>	<0.280>
Postsecondary education		0.013	0.013
		[0.009]	[0.009]
		<0.124>	<0.146>
Spouse of household head		-0.002	-0.002
		[0.005]	[0.005]
		<0.666>	<0.750>
Other relationship to household head		-0.003	-0.002
		[0.006]	[0.006]
		<0.662>	<0.704>
Hunger at time of meal event		0.006**	0.006**
		[0.003]	[0.003]
		<0.068>	<0.480>
Baseline nutrition knowledge		3.45E-04	3.49E-04
		[3.93E-04]	[3.91E-04]
		<0.338>	<0.352>
Order effect (BPP in first meal)			-0.005
			[0.006]
			<0.464>
Constant	0.743***	0.634***	0.634***
	[0.007]	[0.019]	[0.019]
Number of observations	2,227	2,137	2,137
R-squared	0.009	0.113	0.114

Robust standard errors in brackets; Wild cluster bootstrap-t p-value in <>*** p<0.01, ** p<0.05, * p<0.1

Table 2-7. Treatment effects on food item consumption without covariates

VARIABLES	(1) Rice	(2) Chicken	(3) Fish	(4) Egg	(5) Lentil	(6) Salad	(7) Mixed veg	(8) Leafy veg	(9) Fruit	(10) Yogurt
Nutrition education	-0.007	0.007**	0.001	0.003	0.014**	0.004	0.004	0.005*	0.002	0.005
	[0.013]	[0.003]	[0.002]	[0.002]	[0.006]	[0.003]	[0.004]	[0.003]	[0.003]	[0.003]
	<0.608>	<0.200>	<0.586>	<0.326>	<0.596>	<0.436>	<0.416>	<0.320>	<0.452>	<0.328>
Nutrition and gender education	-0.013	0.003	0.002	0.001	0.016***	0.002	0.003	0.005**	0.004	0.005
	[0.013]	[0.002]	[0.003]	[0.002]	[0.005]	[0.003]	[0.004]	[0.003]	[0.003]	[0.004]
	<0.386>	<0.256>	<0.418>	<0.452>	<0.270>	<0.556>	<0.442>	<0.278>	<0.290>	<0.466>
BPP intervention	0.010	-0.001	-0.004	0.003	0.011	0.003	-0.003	0.002	-0.004	-0.004
	[0.015]	[0.005]	[0.005]	[0.003]	[0.008]	[0.007]	[0.005]	[0.003]	[0.006]	[0.006]
	<0.544>	<0.922>	<0.470>	<0.370>	<0.600>	<0.732>	<0.616>	<0.608>	<0.626>	<0.600>
BPP x nutrition education	-0.012	-2.05E-04	0.002	0.003	0.029***	0.004	0.003	0.003	0.007	0.005
	[0.018]	[0.004]	[0.006]	[0.003]	[0.010]	[0.007]	[0.006]	[0.004]	[0.007]	[0.007]
	<0.534>	<0.948>	<0.708>	<0.428>	<0.840>	<0.718>	<0.634>	<0.546>	<0.670>	<0.560>
BPP x nutrition and gender education	-0.006	0.001	-0.003	-0.001	0.020**	0.001	0.002	0.005	0.007	0.003
	[0.017]	[0.004]	[0.005]	[0.003]	[0.010]	[0.005]	[0.005]	[0.005]	[0.007]	[0.007]
	<0.722>	<0.722>	<0.640>	<0.800>	<0.768>	<0.888>	<0.680>	<0.568>	<0.640>	<0.688>
Constant	0.386***	0.074***	0.076***	0.058***	0.079***	0.046***	0.068***	0.051***	0.066***	0.079***
	[0.011]	[0.003]	[0.003]	[0.002]	[0.006]	[0.004]	[0.003]	[0.002]	[0.005]	[0.005]
Number of observations	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227	2,227
R-squared	0.002	0.004	0.003	0.004	0.010	0.001	0.002	0.002	0.004	0.003

Robust standard errors in brackets; Wild cluster bootstrap-t p-value in <>*** p<0.01, ** p<0.05, * p<0.1

Table 2-8. Treatment effects on food item consumption with covariates

VARIABLES	(1) Rice	(2) Chicken	(3) Fish	(4) Egg	(5) Lentil	(6) Salad	(7) Mixed veg	(8) Leafy veg	(9) Fruit	(10) Yogurt
Nutrition education	-0.009	0.005	-0.001	0.001	0.013**	0.004	0.004	0.005**	0.003	0.005
	[0.013]	[0.003]	[0.002]	[0.002]	[0.005]	[0.003]	[0.003]	[0.002]	[0.003]	[0.003]
	<0.530>	<0.336>	<0.676>	<0.606>	<0.402>	<0.446>	<0.428>	<0.234>	<0.500>	<0.268>
Nutrition and gender education	-0.015	0.002	0.002	2.50E-04	0.017***	0.002	0.003	0.005*	0.004*	0.004
	[0.013]	[0.003]	[0.003]	[0.002]	[0.004]	[0.003]	[0.004]	[0.003]	[0.002]	[0.004]
	<0.346>	<0.452>	<0.558>	<0.880>	<0.114>	<0.536>	<0.498>	<0.290>	<0.254>	<0.428>
BPP intervention	0.002	-0.002	-0.007	0.001	0.006	0.002	-0.004	3.07E-04	-0.001	-0.004
	[0.014]	[0.004]	[0.004]	[0.002]	[0.005]	[0.006]	[0.005]	[0.003]	[0.006]	[0.005]
	<0.886>	<0.572>	<0.356>	<0.680>	<0.406>	<0.722>	<0.528>	<0.936>	<0.882>	<0.526>
BPP x nutrition education	-0.022	-0.002	-0.001	0.001	0.023***	0.004	0.003	0.002	0.009	0.005
	[0.017]	[0.004]	[0.005]	[0.003]	[0.007]	[0.005]	[0.005]	[0.003]	[0.007]	[0.006]
	<0.332>	<0.652>	<0.898>	<0.778>	<0.386>	<0.646>	<0.634>	<0.522>	<0.652>	<0.532>
BPP x nutrition and gender education	-0.009	2.10E-04	-0.005	-0.002	0.017**	-1.84E-05	0.001	0.003	0.008	0.002
	[0.014]	[0.004]	[0.004]	[0.003]	[0.008]	[0.004]	[0.004]	[0.004]	[0.007]	[0.006]
	<0.534>	<0.976>	<0.378>	<0.538>	<0.472>	<0.996>	<0.836>	<0.476>	<0.612>	<0.846>
Mymensingh district	-0.054**	0.009*	0.019***	-0.008***	0.050***	0.020***	-0.017***	-0.036***	0.045***	0.043***
	[0.020]	[0.005]	[0.003]	[0.002]	[0.007]	[0.007]	[0.006]	[0.004]	[0.007]	[0.007]
	<0.346>	<0.460>	<0.044>	<0.102>	<0.648>	<0.992>	<0.760>	<0.532>	<0.984>	<0.796>
Household monthly income	3.27E-07	-1.28E-08	-4.95E-08	-6.15E-08	-3.41E-07	-1.21E-07	8.86E-08	-4.50E-08	5.00E-08	-1.74E-08
	[3.49E-07]	[1.50E-07]	[7.34E-08]	[5.10E-08]	[3.21E-07]	[1.25E-07]	[1.60E-07]	[9.86E-08]	[1.67E-07]	[1.86E-07]
	<0.422>	<0.926>	<0.534>	<0.286>	<0.586>	<0.494>	<0.624>	<0.668>	<0.792>	<0.938>
Poverty score	-0.001*	-2.32E-05	-4.86E-04	3.96E-05	8.46E-06	-3.99E-05	1.86E-04*	3.07E-05	-2.01E-04	2.04E-05
	[3.98E-04]	[8.64E-05]	[7.50E-05]	[4.46E-05]	[1.87E-04]	[7.87E-05]	[1.11E-04]	[8.46E-05]	[1.03E-04]	[1.23E-04]
	<0.212>	<0.804>	<0.338>	<0.398>	<0.960>	<0.664>	<0.372>	<0.738>	<0.830>	<0.872>
Number of food groups produced	-0.004*	1.85E-04	4.32E-04	-7.46E-05	-2.84E-04	7.42E-05	-6.37E-06	2.65E-04	-0.001	-4.72E-04
	[0.002]	[0.001]	[4.39E-04]	[3.00E-03]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
	<0.226>	<0.780>	<0.390>	<0.802>	<0.772>	<0.894>	<0.992>	<0.664>	<0.552>	<0.576>

Table 2-8. Continued.

VARIABLES	(1) Rice	(2) Chicken	(3) Fish	(4) Egg	(5) Lentil	(6) Salad	(7) Mixed veg	(8) Leafy veg	(9) Fruit	(10) Yogurt
Household food insecurity access score	0.002	0.001**	1.52E-04	3.39E-05	4.23E-04	2.04E-04	0.001*	-1.88E-04	1.91E-04	0.001*
	[0.002]	[4.21E-04]	[2.30E-04]	[4.46E-05]	[3.81E-04]	[3.43E-03]	[4.56E-04]	[2.96E-04]	[2.96E-04]	[4.77E-04]
	<0.352>	<0.386>	<0.556>	<0.862>	<0.370>	<0.656>	<0.478>	<0.590>	<0.598>	<0.482>
Religion (Muslim / non-Muslim)	0.116***	0.019**	0.012***	0.021***	0.004	-0.004	0.017*	0.020***	-0.015**	-0.021**
	[0.033]	[0.008]	[0.004]	[0.006]	[0.009]	[0.016]	[0.010]	[0.006]	[0.006]	[0.009]
	<0.658>	<0.824>	<0.316>	<0.884>	<0.744>	<0.878>	<0.840>	<0.760>	<0.466>	<0.658>
Female	-0.055***	-0.011***	-0.015***	-0.006***	-0.050***	-0.014***	-0.007	-0.003	0.010	-0.004
	[0.014]	[0.004]	[0.004]	[0.002]	[0.011]	[0.005]	[0.005]	[0.003]	[0.007]	[0.005]
	<0.040>	<0.212>	<0.138>	<0.680>	<0.978>	<0.880>	<0.520>	<0.542>	<0.736>	<0.572>
Age	-7.02E-05	-1.51E-03*	-3.46E-05	-9.41E-05**	1.61E-04	-3.41E-05	-1.76E-04	-1.52E-04**	2.38E-04**	1.41E-04
	[3.57E-03]	[8.77E-05]	[9.26E-05]	[4.53E-05]	[1.93E-04]	[9.17E-05]	[1.29E-04]	[6.82E-04]	[1.07E-04]	[1.06E-04]
	<0.848>	<0.230>	<0.736>	<0.100>	<0.556>	<0.764>	<0.460>	<0.232>	<0.328>	<0.354>
Primary school (highest level)	1.98E-03	0.001	-0.003	-4.43E-04	0.005	-4.04E-05	0.003	-0.001	0.002	0.002
	[0.011]	[0.002]	[0.002]	[0.001]	[0.004]	[0.003]	[0.003]	[0.002]	[0.002]	[0.002]
	<0.990>	<0.602>	<0.320>	<0.648>	<0.458>	<0.982>	<0.484>	<0.638>	<0.554>	<0.404>
Junior secondary school (highest level)	-0.006	0.005	-0.004	-0.002	-0.011	-0.003	0.003	-0.002	-0.005	-0.007
	[0.016]	[0.004]	[0.003]	[0.001]	[0.010]	[0.004]	[0.004]	[0.003]	[0.005]	[0.004]
	<0.704>	<0.308>	<0.238>	<0.202>	<0.610>	<0.578>	<0.512>	<0.536>	<0.480>	<0.292>
Secondary school (highest level)	-0.015	0.001	0.004	0.001	-0.002	1.75E-04	0.014**	0.006	-0.003	0.006
	[0.021]	[0.005]	[0.003]	[0.002]	[0.009]	[0.005]	[0.006]	[0.005]	[0.006]	[0.006]
	<0.538>	<0.778>	<0.244>	<0.736>	<0.846>	<0.968>	<0.352>	<0.426>	<0.646>	<0.420>
SSC pass (highest level)	-0.000	0.004	0.004	0.001	-0.000	0.005	0.001	-1.30E-03	-0.001	0.008
	[0.014]	[0.004]	[0.004]	[0.002]	[0.009]	[0.006]	[0.006]	[0.004]	[0.007]	[0.005]
	<0.970>	<0.358>	<0.460>	<0.706>	<0.978>	<0.530>	<0.894>	<0.974>	<0.952>	<0.200>
Postsecondary education (highest level)	-0.054**	0.005	-0.006	0.002	-0.002	0.014**	0.005	0.006	-0.002	0.003
	[0.024]	[0.005]	[0.004]	[0.002]	[0.014]	[0.006]	[0.006]	[0.004]	[0.007]	[0.007]
	<0.278>	<0.350>	<0.222>	<0.450>	<0.906>	<0.470>	<0.512>	<0.454>	<0.724>	<0.648>

Table 2-8. Continued.

VARIABLES	(1) Rice	(2) Chicken	(3) Fish	(4) Egg	(5) Lentil	(6) Salad	(7) Mixed veg	(8) Leafy veg	(9) Fruit	(10) Yogurt
Spouse of household head	0.032**	-2.64E-04	0.003	1.77E-05	0.003	0.004	0.005*	0.003	0.005	0.004
	[0.013]	[0.003]	[0.002]	[0.001]	[0.005]	[0.004]	[0.003]	[0.003]	[0.003]	[0.004]
	<0.136>	<0.934>	<0.288>	<0.988>	<0.620>	<0.630>	<0.272>	<0.462>	<0.414>	<0.460>
Other relationship to household head	0.005	-1.01E-05	-0.001	-0.001	-0.010	-0.002	-0.001	-1.68E-05	-0.004	-0.001
	[0.016]	[0.004]	[0.003]	[0.002]	[0.007]	[0.004]	[0.005]	[0.003]	[0.005]	[0.005]
	<0.746>	<0.996>	<0.656>	<0.622>	<0.434>	<0.686>	<0.902>	<0.998>	<0.518>	<0.908>
Hunger at time of meal event	0.001	0.002	0.004***	2.77E-04	0.001	0.002	3.38E-04	0.003**	0.001	0.004**
	[0.006]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]
	<0.904>	<0.510>	<0.524>	<0.798>	<0.650>	<0.760>	<0.850>	<0.438>	<0.770>	<0.658>
Baseline nutrition knowledge	4.01E-04	1.40E-04	1.02E-04	-1.36E-05	-4.46E-04	2.05E-04	0.001*	-9.50E-06	3.42E-04	0.001**
	[0.001]	[1.95E-04]	[1.73E-04]	[1.07E-04]	[3.85E-04]	[2.07E-04]	[2.72E-04]	[1.90E-04]	[2.19E-04]	[2.96E-04]
	<0.654>	<0.544>	<0.580>	<0.902>	<0.418>	<0.516>	<0.384>	<0.948>	<0.296>	<0.342>
Constant	0.370***	0.052***	0.053***	0.050***	0.087***	0.040***	0.045***	0.047***	0.031**	0.042***
	[0.039]	[0.012]	[0.010]	[0.008]	[0.021]	[0.015]	[0.017]	[0.008]	[0.015]	[0.013]
Number of observations	2,137	2,137	2,137	2,137	2,137	2,137	2,137	2,137	2,137	2,137
R-squared	0.097	0.076	0.161	0.072	0.190	0.098	0.029	0.144	0.146	0.177

Robust standard errors in brackets; Wild cluster bootstrap-t p-value in <>*** p<0.01, ** p<0.05, * p<0.1

CHAPTER 3
REPEATED EXPOSURE TO A BEHAVIORAL NUDGE IN THE HOME AND NUTRITION EDUCATION: LONG-TERM IMPACTS ON DIETARY DIVERSITY

Motivation

Many developing countries have made progress in food security, yet malnutrition persists in terms of micronutrient deficiencies due to low dietary quality (Iannottie et al., 2009; World Bank, 2013). This problem is often referred to as “hidden hunger” (Iannottie et al., 2009). In particular, vitamin A and iron deficiencies plague the adult population in several low-income countries (Iannottie et al., 2009). Increasing dietary diversity can improve micronutrient deficiencies since consuming a wider variety of food increases nutrient intake (Iannottie et al., 2009; Hatloy et al., 1998; Torheim et al., 2004). Thus, to combat the hidden hunger problem, many development initiatives promote diet diversification through activities such as homestead gardening, community health campaigns, and cooking demonstrations, designed to help disseminate nutrition guidelines.

Several countries have adopted science-based tools known as food-based dietary guidelines (FBDG) to deliver country-specific nutrition messages with a focus on locally available food items (FAO, 2016). The USDA MyPlate is the official FBDG diagram used in the United States. Studies have shown the USDA MyPlate is an effective nudge that encourages individuals to choose healthier food items (Brown et al., 2014; Miller et al., 2016). A ‘nudge’ is a subtle cue that encourages an individual to change behavior without restricting his or her choice set (Thaler and Sunstein, 2009). Miller et al. (2016) employ two behavioral economics strategies, pre-ordering and MyPlate prompts, to the selection of food items among elementary and middle school students enrolled in the U.S. National School Lunch Program (NSLP). Prompting, or nudging, students with MyPlate messages during the pre-ordering process results in larger increases in the selection of fruits, vegetables, and low-fat milk of 51.4%, 29.7%, and 37.3%,

respectively, compared to pre-ordering alone. Brown et al. (2014) measures changes in self-reported food frequency when college students are exposed to MyPlate prompts via text message. The study finds exposure to MyPlate messages increases the consumption of fruits by 13% and vegetables by 8% compared to the control group. Leak et al. (2015) introduces protocol for parents to use behavioral economics strategies in the home to nudge children toward eating more vegetables with dinner. One strategy instructs parents to serve dinner on a disposable plate outlining proper vegetable portioning according to MyPlate guidelines. Contrary to Brown et al. (2014) and Miller et al. (2016), an evaluation of these strategies finds weak evidence that a MyPlate nudge increases reported frequency of vegetable intake in the home (Leak, 2017).

In 2013 a plate-based diagram similar to the MyPlate was developed by the SHIKHA[1] project in Bangladesh. The diagram illustrates dietary recommendations and proper portioning using pictures of locally sourced food items. As a tool for disseminating nutrition messages under the SHIKHA project, the diagram and key written messages[2] were printed on a melamine plate, which we will refer to as the Bengali Portion Plate (BPP). The Bangladesh Ministry of Health and Family Welfare adopted the BPP for use as a counseling tool to improve maternal and child nutrition (FHI360/USAID, 2016). Although the BPP was designed to target pregnant and lactating women, the guidelines portrayed by the plate fit the dietary recommendations for the general Bangladeshi population, male or female. This essay investigates whether the use of the BPP in the home environment effectively nudges nutrition decisions among rural households.

[1] The SHIKHA project is a USAID initiative implemented by FHI360 and BRAC to promote dietary diversity and improved nutrition among pregnant and lactating women in Bangladesh

[2] The food plate follows the national dietary guidelines for Bangladesh and also promotes messages for child and maternal nutrition including: “Eating a variety of food in appropriate amounts keeps mothers and children healthy” and “Eat a little more food during pregnancy.”

Behavioral economics is increasingly applied to research in development economics; however, its application to nutrition in low-income countries is relatively new. The World Bank recently implemented a study on nudging mothers in Madagascar to purchase healthier food (World Bank, 2016a). At this time, the experiment is ongoing. Thus, our research is one of the first contributions to the literature on nutrition nudging in development. To date, most nutrition and health interventions in developing countries have focused on tools for behavior change communication (BCC).

Behavioral economics (BE) differs from BCC in that BE discreetly encourages individuals to make decisions without influencing their beliefs or values, whereas BCC uses various messaging sources to specifically promote change in the knowledge, beliefs, and values of an individual or a community. A common example of BCC is the promotion of health and nutrition by community health workers. In a randomized controlled trial in Malawi, Fitzsimons et al. (2016) finds that visits from counselors on child nutrition increase per-capita monthly food consumption of protein-rich foods, fruits, and vegetables in the household. Similarly, a community growth promotion program evaluation in Uganda finds higher consumption of legumes, milk, fruits, and vegetables among children in households visited by community health workers (Alderman, 2007).

The interventions in the aforementioned studies promote best practices for child nutrition. Our research departs from the nutrition development literature in that it focuses on nutrition education and nudging to improve individual dietary diversity among adults. Encouraging adults' consumption of fruits and vegetables is particularly important for socioeconomically disadvantaged households (Ansem et al., 2014; Ball et al. 2006; Campbell et al., 2013). Educating adults can lead to better feeding practices for children since parents make the rules

and decisions about food consumed in the household (Wong et al., 2014; van Ansem et al., 2014). In a study of schoolchildren in China, Wong et al. (2014) find child hemoglobin levels improve when parents engage in participatory training on nutrition and anemia. In a Dutch study, van Ansem et al. (2014) finds the home availability of fruits and vegetables increases when adults are encouraged to consume healthy food. The presence of fruits and vegetables improves the home food environment such that children have more access to healthy foods (van Ansem et al., 2014). Acknowledging adult behavior as an agent for change in household nutrition, the intervention in this study combines behavioral economic strategies with behavior change communication to promote healthy food choices among adults in rural Bangladesh.

To our knowledge, there have been no studies on the use of plate-based food diagrams to nudge the consumption of healthy foods and dietary diversity in developing countries. Thus, we make a novel contribution to research on nutrition nudging in development by applying behavioral economics methods to dietary diversity in Bangladesh. Even within the U.S. literature on behavioral economics in nutrition, few studies evaluate the use of such strategies in the home environment, which is the focus of this analysis. Our experiment uniquely combines behavioral economics with BCC in the random assignment of both exposure to the BPP, a BE tool, and nutrition education through participatory training, a method of BCC. Because of its unique design and the focus on the home environment, the experimental protocol in this research is important to inform future studies on nutrition nudges in both the developed and developing world.

By randomly assigning exposure to the BPP, this study investigates the effectiveness of the BPP at nudging both men and women in rural Bangladesh toward more diversified diets. Treated participants were first exposed to the BPP during a lunch buffet where food choices were

discreetly observed. After the meal BPPs were distributed to treated participants for use at home. Each participant received one BPP for each member of his or her family. In this essay we measure whether exposure to the BPP in the home environment impacts individual dietary diversity. Our experiment also includes a second level of treatment, nutrition education through a participatory workshop. This research aims to measure the impact of repeated exposure to nutrition guidelines via a nutrition education and a plate printed with a FBDG icon. Thus, we measure the impacts of the BPP alone and when combined with nutrition education. We also measure the individual impacts of nutrition education. In a randomized controlled trial we evaluate whether exposure to the BPP will nudge individuals in rural Bangladesh toward more diverse diets at home. The results from a difference-in-difference analysis on the 24-hour individual dietary diversity score fail to provide evidence that the BPP nudges study participants toward dietary diversity. However, over a longer reference period, we see a positive impact of the BPP nudge on dietary diversity measured by the food consumption score. The study advocates a need for future research on nutrition nudges in developing countries and develops protocol for conducting such research.

The next section of this essay describes the experimental design and treatment assignment. The empirical methodology is then defined, followed by results and possible explanations for our findings. The essay concludes with a discussion on the relevance of our study and suggestions for future research.

Experimental Design

A randomized experiment to evaluate the impacts of two nutrition interventions, satisfying both BE and BCC properties, was conducted from August 2016 to January 2017 in two districts of Bangladesh. Data from the experiment include a baseline survey, two meal observations, and an endline survey for 1,099 individuals from 53 villages across two districts in

Bangladesh. In the baseline survey, the participant provided information on demographics in a household roster, individual and household 24-hour food group consumption, 7-day food group consumption, nutrition knowledge, poverty, food insecurity, and agricultural production. The endline survey mirrored the baseline questionnaire, but also included questions about the nutrition workshop (i.e. the field experiment described below) and the receipt and use of the BPP at home. In addition to the surveys, each individual participated in a field experiment, which involved attending two meal events, approximately one month apart. The baseline survey was conducted as a face-to-face interview at the participant's household at least one day prior to the first meal event. The endline survey, also a face-to-face interview, was conducted at the participant's household at least one month after the second meal event.

Participants for the study were randomly selected from the membership rosters of the Bangladesh Agricultural University Extension Center (BAUEC) in the Mymensingh district and Shushilan, a NGO in the Borguna district. The research was funded by the USAID initiative "Integrating Gender and Nutrition within Agricultural Extension Services (INGENAES)," thus one objective was to coordinate research alongside local extension providers. The specific partner agencies were selected on the criteria that they provide technical agricultural assistance to their respective beneficiaries, but had not established protocol for disseminating nutrition guidelines to rural households at the time of the study. BAUEC serves male and female farmers, 55% and 45%, respectively, in the Mymensingh district. Shushilan is a national organization; however, we partnered specifically with the "Managing Natural Resources by the Coastal Community" (MaNaR) project in the Borguna district. The MaNaR project is targeted specifically toward rural women, thus its beneficiary roster is 94% female.

The primary objective of this experiment was to investigate the impact of repeated exposure to nutrition guidelines using different mediums. As such, participants were randomly assigned to two nutrition interventions: 1) exposure to the BPP and 2) nutrition education in a participatory workshop. Participants who were assigned to the BPP treatment were first exposed to the tool during a lunch buffet where they were also given the BPP to use at home. Thus, the BPP intervention was cluster-randomized at the village level to reduce potential spillover effects during at-home use that would contaminate the control group. Nutrition education was randomly assigned at the individual participant level.

Each participant was invited to his or her respective field office, BAEUC or Shushilan, for a lunch buffet on two occasions, one month apart. All attendees were from the same village on any given day. Enumerators conducted a baseline survey at the participant's household at least one day prior to the first meal. The BPP intervention was implemented in terms of the plate that participants used during the lunch buffet. The control group used a standard plate during both buffet meals. Individuals from treated villages served themselves using the BPP during one of the two events and a standard plate during the other event (Figure 2-1). Some villages used the BPP during the first meal while others used the BPP in the second meal. During the meal, data collectors discreetly observed participants' food choices. The meal observation data collection protocol and analysis are described in Chapter 2. If the participant used a BPP during the meal, he or she was given one BPP for each member of his or her household to use at home after the meal.

The nutrition education intervention was implemented in the morning, prior to each lunch buffet. Individuals who were assigned to the nutrition education treatment arrived early to participate in the workshop(s) described below. The nutrition education assignment remained the

same during both of the two meals. Participants who were assigned to the control group for nutrition education simply attended the lunch buffet and did not attend any nutrition workshops.

The nutrition education intervention encompassed two levels of treatment: 1) nutrition education only and 2) nutrition education with a gender component. Individuals were randomly assigned to one of the two treatments or the control group of no nutrition education. The trainings followed the small-group participatory methods of two activities described in Henderson (2016). Specifically, the nutrition education intervention followed the "What Goes on the Plate" activity in which participants were asked to draw a circle representing a plate and illustrate food items that characterize a balanced diet within that plate. A group representative then shared and described the illustration to open a discussion among the participants. In a complementary activity, groups were given a budget and asked to prepare a shopping list for a balanced meal within that budget. To conclude the session the facilitator summarized the national dietary guidelines, presented examples of healthy food items, and encouraged the consumption of healthy foods such as fruits and vegetables. The national dietary guidelines coincide with the information on the BPP, however the facilitator did not explicitly show the BPP during the workshop.

Individuals who were also assigned to the gender component of the BCC intervention participated in the "Who Gets What to Eat" activity in addition to the nutrition education. In this activity, each participant was assigned to role-play as a different member of the household (wife, husband, father-in-law, daughter, etc.). The person assigned to the role of wife distributed food items to each member, mimicking traditional household gender roles for food allocation. A discussion then ensued about the nutritional needs of men and women as well as the importance

of including protein, fruits and vegetables in women's diets, particularly for adolescent, pregnant, and lactating women.

Empirical Analysis

The baseline and endline survey data are evaluated using difference-in-difference analysis to measure the impacts of the BPP and nutrition education interventions on dietary diversity at home. The difference-in-difference model estimates changes in the individual dietary diversity score, IDDS, as a function of the interventions, controlling for changes in dietary diversity over time in the control group. Following FAO guidelines for dietary diversity, IDDS is a count of the number of food groups consumed by the individual in the last 24 hours, [0,15] (Kennedy, 2010). In addition to the IDDS, we estimate the change in the household food consumption score (FCS), a 7-day measure of dietary diversity and frequency of consumption. By design, the FCS weights different food groups by nutrient value in addition to recording frequency of consumption (WFP, 2008). Following the calculation steps in WFP (2008), we multiply the frequency of consumption of nine different food groups by the defined weight of that food group. The FCS is the sum of the weighted consumption frequencies. In this analysis, FCS remains a continuous variable ranging from 0 to 112. Evaluating both IDDS and FCS provides a more comprehensive picture of potential outcomes since the two measures vary by reference period and the FCS accounts for nutrient content (FAO and WFP, 2012).

The following equation presents the general form of the model for individual i in randomized cluster j at time t, where D is the respective dietary diversity score, *IDDS* or *FCS*.

$$
\begin{aligned}
D_{ijt} = {} & \alpha_0 + \alpha_1 post_{ijt} + \beta_1 BPP_{ijt} + \beta_2 nutritionED_{ijt} + \beta_3 genderED_{ijt} \\
& + \beta_4 nutritionED\ x\ BPP_{ijt} + \beta_5 genderED\ x\ BPP_{ijt} + \delta_1 post\ x\ BPP_{ijt} \\
& + \delta_2 post\ x\ nutritionED_{ijt} + \delta_3 post\ x\ genderED_{ijt} + \delta_4 post\ x\ BPP\ x\ nutritionED_{ijt} \\
& + \delta_5 post\ x\ BPP\ x\ genderED_{ijt} + X'_{ij}\varphi + \varepsilon_{ijt}
\end{aligned}
\tag{3-1}
$$

In Equation (3-1) *post* is a dummy variable equal to 0 for pre-intervention observations collected in the baseline survey and 1 for post-intervention observations collected in the endline survey. The treatments are indicated in variables *BPP*, *nutritionED,* and *genderED*. Each indicator takes the value of 1 when true and 0 otherwise. *BPP* is a treatment variable equal to 1 for a participant from village *j* randomly assigned to the BPP treatment. *NutritionED* is a dummy variable equal to 1 if the participant was assigned to the nutrition education treatment. The *genderED* variable equal to 1 indicates the individual was assigned to the nutrition education with a gender component treatment. The interaction terms between BPP and the education treatments are dummy variables indicating assignment to both interventions. The n*utritionEDxBPP* variable is equal to 1 when an individual was exposed to the BPP and also received nutrition education. Similarly, *genderEDxBPP* is equal to 1 for an individual who was assigned nutrition education with the gender component and was also assigned to the BPP treatment. The estimated coefficients, δ_1, δ_2, δ_3, δ_4, and δ_5, represent the treatment effects of the BPP intervention, the nutrition education intervention, nutrition and gender education, the BPP combined with nutrition education, and the BPP combined with nutrition and gender education, respectively.

The model includes time-invariant individual and household-level covariates, contained in X_{ij}. To control for geographical differences in agricultural productivity and availability of food, district is a dummy variable equal to 1 if the participant lives in Mymensingh and 0 if the participant lives in Borguna. Demographic indices such as gender, age, and education affect food

preferences as well as the intra-household allocation of food in Bangladesh. Thus, we include gender of the individual as a dummy variable equal to 1 if the participant is female, and 0 otherwise. Age of the individual is a continuous variable. Education is a categorical variable equal to 1 for the highest level of education completed by the individual (no education, primary, junior secondary, secondary, SSC pass, or postsecondary education) where no education is the omitted variable. We hypothesize that a nutrition intervention will have a greater impact if the person receiving the information has control over his or her food choices within the household. Thus, we include food preparer as a dummy variable equal to 1 if the participant is the primary person responsible for preparing meals for the household. Total cultivable land is a continuous variable measured in decimals. Land ownership serves as a proxy for the household poverty level, which impacts the individual's food availability and access. Studies have shown farm diversity is positively correlated with household dietary diversity (Jones et al., 2014; Kumar et al., 2015; Rawlins et al., 2014; Sibhatu et al., 2015). Thus, we include farm diversity measured as the count of food groups produced by the household.

Equation (3-1) is estimated using Poisson regression on IDDS and ordinary least squares regression on FCS. Standard errors are clustered at the village-level for all analyses. To test for robustness, we estimate both models with and without covariates.

Since IDDS is an aggregate measure of all food groups consumed, the outcome does not necessarily capture the treatment effects if a participant simultaneously increases and decreases his or her consumption of different food items. Thus, we also measure the impact of the interventions on the consumption of each food group in a series of logistic regressions. For each of the 15 food groups, the dependent variable is a binary variable indicating whether or not the individual consumed that particular food group in the last 24 hours.

The general form of the model for individual *i* in randomized cluster *j* at time *t* is:

$$\begin{aligned} y_{fijt} = {} & \alpha_0 + \alpha_1 post_{ijt} + \beta_1 BPP_{ijt} + \beta_2 nutritionED_{ijt} + \beta_3 genderED_{ijt} \\ & + \beta_4 nutritionED\ x\ BPP_{ijt} + \beta_5 genderED\ x\ BPP_{ijt} + \delta_1 post\ x\ BPP_{ijt} \\ & + \delta_2 post\ x\ nutritionED_{ijt} + \delta_3 post\ x\ genderED_{ijt} + \delta_4 post\ x\ BPP\ x\ nutritionED_{ijt} \\ & + \delta_5 post\ x\ BPP\ x\ genderED_{ijt} + X'_{ij}\varphi + \varepsilon_{ijt} \end{aligned} \tag{3-2}$$

where y_{fijt} is vector of binary variables equal to 1 if the individual consumed food group *f* in the last 24 hours and 0 otherwise. The treatment variables and covariates in Equation (3-2) follow the definitions in Equation (3-1). Equation (3-2) is estimated using logistic regression with standard errors clustered at the village level.

Results

Table 3-1 presents the pre and post-intervention means for 24-hour consumption of each food group, mean IDDS, and mean FCS by treatment and control. Two-sample tests of proportions (Table 3-2) reveal the increase in mean consumption is statistically significant for several food groups including vegetables, fish, eggs, and fats/oils. There is a statistically significant decrease in meat consumption between the two time periods for two of our treatment groups. Table 3-2 also reports two sample t-tests of the differences in mean IDDS and mean FCS between pre and post-intervention periods by treatment. Mean IDDS and FCS are statistically significantly higher post-intervention for participants in the BPP only and the combined treatment groups. In several cases, statistically significant differences in consumption and IDDS occur within the control group as well as treated participants. The change in dietary diversity in the control group indicates seasonality in food consumption and validates the use of difference-in-difference analysis to control for natural trends in consumption patterns.

The endline survey includes a number of questions about BPP use at home. Prior to analyzing the treatment effects, we first investigate the level of compliance with the BPP

treatment (i.e. whether participants used the BPP at home). Table 3-3 reveals that 11% of all individuals in villages assigned to the BPP treatment never use the BPP at home. Participants across treatment groups use the BPP at similar frequencies and for similar purposes (Table 3-3). Approximately 47% of participants use the BPP to eat meals sometimes (3-4 times in the last 4 weeks) or often (more than 10 times in the last 4 weeks). Similarly, 46% and 48% of participants say they refer to the BPP to make decisions on the type and amount of food to prepare and consume, respectively.

Table 3-4 tabulates noncomplying individuals with the reasons why they never use the BPP at home. The most commonly cited reason for not using the BPP at home is a preference to use other plates to eat meals. Some individuals do not use the BPP due to a lack of access or affordability to food items promoted by the pictorial diagram. However, the number of respondents who say that the BPP is more suitable for use when guests arrive is higher than those who report income or access constraints to BPP use. Perhaps recipients of the BPP view the plate as special dinnerware, which may also explain why the majority of people say they prefer to use other plates to eat their meals.

The results from the difference-in-difference regressions on IDDS are presented in Table 3-5. Model (1) excludes covariates, whereas model (2) includes individual and household characteristics to test for robustness. The results show no evidence of treatment effects for the BPP or nutrition education interventions. None of the treatment variables (*treatment x post)* are statistically significant. The variable *post* captures the time effect; its statistical significance in model (2) reflects a seasonal trend in individual dietary diversity. However, in the 24-hour consumption data there is no causal evidence to suggest the BPP or nutrition education improves

24-hour individual dietary diversity. The results are fairly robust since only small changes in coefficient magnitude arise with the addition of covariates.

It is not surprising to see a lack of treatment effect on IDDS since the aggregate measure of dietary diversity may not reflect simultaneous changes in different food groups. If a participant decreases the consumption of one food group and increases consumption of another food group, IDDS remains unchanged. Thus, we also investigate treatment effects on the 24-hour consumption of each individual food group. The results from the logistic regressions on food group consumption suggest treatment effects exist, but the impact varies by food group and treatment. Our sample contains little to no variation in cereals–most individuals consume rice daily–thus we do not include a regression on cereals. The marginal effects in Tables 3-6 and 3-7 indicate that the nutrition education treatment increases the likelihood of individuals consuming tubers and roots, while the combined treatment increases the likelihood of leafy green vegetable consumption. Respondents assigned to nutrition education with a gender component are 11% more likely to consume tubers and roots compared to individuals who did not participate in trainings or receive the BPP. The combined intervention, exposure to the BPP and nutrition education, increases the likelihood respondents consume leafy green vegetables by 16% compared to the control. Contrary to our hypothesis, nutrition education decreases the likelihood of individuals consuming vitamin A rich vegetables by 12%, compared to the control. Combining nutrition and gender education with the BPP decreases the likelihood of individuals consuming vitamin A rich fruit and fish by 11% and 14%, respectively, compared to the control. As a robustness check, we also run logit regressions on each food group with individual and household-level covariates specified in the previous section. The results in Tables 3-8 and 3-9 show the marginal effects of treatment are consist when covariates are included.

In addition to the 24-hour IDDS model, we measure the treatment effects on the 7-day food consumption score to capture fluctuations in consumption patterns and food availability throughout the week. As expected, we find different results in the 7-day FCS analysis. Taking into account frequency of consumption over a longer period of time, there is some evidence that exposure to the BPP at home improves dietary diversity (Table 3-10). The results show a 3.5 point increase in mean FCS (a 5.2% increase on the mean) among households that received the BPP only, compared to households that were not assigned to either treatment. The combined treatment–BPP with nutrition education–increased the FCS by 3.7 points (a 5.4% increase on the mean) compared to the control. The results also show a 3.4 point increase in mean FCS among households that received nutrition and gender education, but were not assigned to the BPP treatment, compared to the control. Model (2) in Table 3-10 presents the estimated impact on FCS controlling for individual and household-level covariates. We find a slightly lower magnitude of treatment effects when covariates are included.

Discussion

The results from this study provide mixed evidence on the long-term effectiveness of the BPP and nutrition education interventions. We find no statistically significant treatment effects on individual dietary diversity. On the other hand, the analysis on the 7-day food consumption score presents some evidence that the BPP nudges households to consume a greater variety of food more frequently. The results show the BPP nudge increases the FCS, and the combined intervention of the BPP nudge with nutrition education also generates a positive impact on the frequency of diverse food items consumed in the household. Furthermore, our findings suggest nutrition education with the gender component improves FCS, but nutrition education alone is not effective. This discrepancy in education impact may be due to the reiteration of information. Some of the key nutrition messages were repeated during the gender training. Thus participants

in the dual education treatment may have retained more information, and hence the long-term effects were sustainable. Further research should measure retention rates of information disseminated via participatory workshops.

Investigating the change in 24-hour consumption for each food group reveals few significant treatment effects and no clear pattern. The proportion of individuals consuming leafy green vegetables and white tubers is higher among some treated participants. Contrarily, the proportion of individuals consuming fish and vitamin A rich fruit is lower among some treated participants. There is not enough evidence from the analysis on 24-hour consumption to suggest the individuals respond to either the BPP or nutrition education interventions in a consistent manner. However, the results show that the combined intervention of the BPP with nutrition education promotes leafy green vegetable consumption. The effect may be explained by the prominence of leafy green vegetables on the BPP as well as the food group's affordability and availability as a source of nutrients in Bangladesh. A variety of products in the leafy green vegetable food group (i.e. red amaranth, spinach, jute leaves, pumpkin leaves) are available in the study areas. Thus, participants may have responded to the nutrition messages by increasing their consumption of nutrients in the most affordable and accessible way. The simultaneous decrease in the consumption of other food groups among the treated suggests the participants may be substituting one food group for another. Traditional constraints to accessing diverse food items, such as availability or affordability of healthy food, may explain the different outcomes by food group and frequency of consumption. Further research should explore whether the effectiveness of the BPP nudge varies based on the number of times the treated household member goes to market over the 7-day time period.

The rate of usage of the BPP at home may also contribute to the difference in impact on IDDS versus FCS. Eleven percent of our treated sample never uses the BPP at home. In other words, there is some lack of compliance with the randomly assigned BPP treatment. Participants who do not use the BPP despite receiving it claim to prefer using other plates during meals at home. Some non-compliers report saving the BPP for use when guests arrive. Thus, rather than the BPP acting as a nudge to increase dietary diversity, households store the BPP as a treasured item. The frequency of BPP use may also explain the difference in treatment effects between IDDS and FCS. Twenty percent of individuals who received the BPP use it at least biweekly ("often") to make decisions about food consumption, whereas 25% or more report only referring to the BPP "sometimes." Further analysis investigating the heterogeneity of treatment effects by frequency of BPP use is needed. Similarly, future research should investigate the characteristics of the individuals in the household who are using the BPP and explore the heterogeneity of treatment effects by user. In addition to BPP use, we plan to investigate the extent to which participants shared the information from the BPP and nutrition education with their family and community members. Specifically, we will use network analysis techniques to investigate the spread of information since the endline survey asked participants to identify the individuals with whom they shared information about the interventions.

A potential limitation of this study is the sampling strategy. Since the participants were randomly selected from the membership rosters of our partner agencies, the results are not representative of the national population. Participants' membership in our partner organization might affect our results since extension activities vary by agency. In particular, the Shushilan MaNaR project emphasizes climate change resilient food production methods such as floating gardens. The different nature of the partner agencies' technical services influences the

accessibility and availability of nutritious food items in the home. The pre-existing relationship between the partner organization and the participant also potentially biases the responsiveness of participants to the information treatments. Furthermore, participants were compensated for their time in this study. This compensation may have affected the receptiveness of participants to the information.

The methods in this study can be applied to a nationally representative sample to measure the impacts of scaling up behavioral economics and behavior change communication initiatives. Future studies should investigate the use of nutrition nudges using FBDG icons in the home environment in the context of other countries. Further investigation is also warranted to examine whether nutrition initiatives result in food group substitution by individuals in low-income countries. The research should be extended to understand whether smallholder farmers' production decisions change as a result of nutrition initiatives and the extent to which production decisions reflect potential consumption substitution patterns.

Table 3-1. Pre and post-intervention mean 24 hour consumption of food groups by treatment and control[+]

	Control		BPP only		Nutrition education		Nutrition & gender education		BPP x nutrition		BPP x nutrition & gender	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Cereals	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00
Vitamin A rich vegetables	0.19	0.38	0.14	0.32	0.21	0.26	0.19	0.31	0.20	0.30	0.19	0.38
Tubers and roots	0.76	0.66	0.78	0.68	0.82	0.78	0.65	0.70	0.77	0.70	0.77	0.72
Leafy green vegetables	0.58	0.51	0.51	0.54	0.54	0.55	0.63	0.53	0.45	0.54	0.56	0.60
Other vegetables	0.50	0.68	0.49	0.72	0.58	0.69	0.52	0.77	0.53	0.65	0.55	0.68
Vitamin A rich fruit	0.04	0.17	0.04	0.11	0.04	0.15	0.07	0.09	0.04	0.10	0.11	0.13
Other fruit	0.26	0.19	0.29	0.16	0.20	0.18	0.20	0.18	0.25	0.19	0.29	0.21
Meat	0.40	0.29	0.29	0.26	0.39	0.31	0.37	0.23	0.30	0.21	0.33	0.27
Eggs	0.19	0.27	0.21	0.34	0.22	0.29	0.23	0.33	0.24	0.33	0.23	0.34
Fish	0.77	0.88	0.72	0.76	0.64	0.79	0.78	0.81	0.73	0.79	0.78	0.76
Pulses	0.53	0.55	0.52	0.48	0.54	0.50	0.45	0.54	0.57	0.50	0.50	0.58
Dairy	0.17	0.23	0.19	0.24	0.12	0.19	0.18	0.23	0.22	0.22	0.22	0.26
Fats and oils	0.93	0.97	0.92	0.98	0.89	0.98	0.98	1.00	0.89	0.96	0.89	0.97
Sugar	0.17	0.30	0.23	0.33	0.19	0.25	0.19	0.23	0.25	0.32	0.25	0.30
Spices	0.75	0.82	0.78	0.89	0.77	0.75	0.80	0.83	0.75	0.84	0.74	0.83
Individual dietary diversity score (IDDS)	7.25	7.92	7.11	7.82	7.15	7.68	7.25	7.78	7.19	7.66	7.39	8.00
	(2.19)	(3.39)	(2.40)	(2.90)	(2.10)	(3.09)	(2.05)	(2.87)	(2.44)	(2.95)	(2.81)	(2.91)
Food consumption score (FCS)	67.92	67.89	67.56	71.28	66.06	69.68	66.28	69.19	68.44	72.01	69.15	72.62
	(13.71)	(17.73)	(18.86)	(17.84)	(17.08)	(18.63)	(15.23)	(16.67)	(18.40)	(18.80)	(18.29)	(17.29)

Note: standard deviation of IDDS and FCS in ( ).

[+]In this study, the BPP is a behavioral economics intervention and nutrition education is a behavior change communication strategy.

Table 3-2. Test of differences in pre-intervention and post-intervention mean 24 hour consumption of food groups by treatment[+]

Food group (Post – Pre)	Control	BPP only	Nutrition education	Nutrition & gender education	BPP x nutrition	BPP x nutrition & gender
Vitamin A rich vegetables	3.09**	4.60**	0.90	1.92	2.69**	4.91**
	<0.002>	p < 0.001	<0.368>	<0.055>	<0.007>	p < 0.001
Tubers and roots	-1.62	-2.06**	-0.94	0.35	-1.56	-0.97
	<0.106>	<0.039>	<0.349>	<0.728>	<0.118>	<0.334>
Leafy green vegetables	-0.93	0.81	0.25	-2.19**	2.29**	1.34
	<0.350>	<0.420>	<0.799>	<0.029>	<0.022>	<0.180>
Other vegetables	2.71**	4.82**	1.97**	3.80**	2.72**	3.10**
	<0.007>	p < 0.001	<0.049>	p < 0.001	<0.007>	<0.002>
Vitamin A rich fruit	3.02**	2.80**	2.68**	0.73	2.79**	0.49
	<0.003>	<0.005>	<0.007>	<0.464>	<0.005>	<0.626>
Other fruit	-1.11	-2.90**	-0.80	-0.91	-1.55	-1.60
	<0.265>	<0.004>	<0.425>	<0.361>	<0.121>	<0.111>
Meat	-1.68	-1.03	-1.33	-2.14**	-2.37**	-1.59
	<0.093>	<0.304>	<0.182>	<0.032>	<0.018>	<0.112>
Eggs	1.41	3.30**	1.15	1.43	2.40**	2.98**
	<0.158>	<0.001>	<0.250>	<0.154>	<0.016>	<0.003>
Fish	2.09**	1.27	2.80**	0.12	1.41	-0.10
	<0.036>	<0.202>	<0.005>	<0.903>	<0.158>	<0.920>
Pulses	0.27	-0.71	-1.02	1.30	-1.32	1.78
	<0.790>	<0.478>	<0.309>	<0.192>	<0.187>	<0.075>
Dairy	1.17	1.15	1.25	0.97	0.36	0.96
	<0.244>	<0.249>	<0.212>	<0.330>	<0.716>	<0.338>
Fats and oils	1.55	2.77**	3.10**	2.25**	3.01**	3.02**
	<0.122>	<0.006>	<0.002>	<0.024>	<0.003>	<0.003>
Sugar	2.35**	2.41**	1.10	0.80	1.90	1.35
	<0.019>	<0.016>	<0.271>	<0.423>	<0.058>	<0.178>
Spices	1.30	3.14**	0.15	1.08	2.25**	1.81
	<0.193>	<0.002>	<0.880>	<0.280>	<0.024>	<0.070>

Table 3-2. Continued.

Food group (Post – Pre)	Control	BPP only	Nutrition education	Nutrition & gender education	BPP x nutrition	BPP x nutrition & gender
IDDS	1.773**	2.953**	1.490	1.365	2.123**	2.606**
	<0.078>	<0.003>	<0.138>	<0.174>	<0.034>	<0.009>
FCS	0.027	3.728**	3.617	2.912	3.566**	3.468**
	<0.990>	<0.032>	<0.112>	<0.143>	<0.030>	<0.035>

Note: Z-scores and t-score of (Post – pre) reported; p-values are in <>. ****** indicates significance at $\alpha = 0.05$

[+]In this study, the BPP is a behavioral economics intervention and nutrition education is a behavior change communication strategy.

Table 3-3. At home use of BPP by participants

	All treated		BPP only		BPP x nutrition education		BPP x nutrition and gender education	
Frequency of BPP use for participants who received the BPP								
	N	Percent	N	Percent	N	Percent	N	Percent
Use BPP ever	642	89%	205	92%	226	88%	211	89%
Never use BPP	77	11%	19	8%	32	12%	26	11%
How often do you use the BPP to eat your meals?								
Never	104	10%	29	13%	38	15%	35	15%
Rarely	97	9%	26	11%	29	11%	39	16%
Sometimes	212	20%	66	29%	78	30%	64	27%
Often	288	27%	95	41%	101	39%	90	38%
Did not receive	356	34%					1	0.4%
How often do you use the BPP to make decisions on the type of food to prepare?								
Never	113	10%	38	16%	41	15%	31	13%
Rarely	101	9%	29	12%	32	12%	39	16%
Sometimes	291	26%	89	38%	108	40%	92	37%
Often	223	20%	68	29%	77	29%	74	30%
Did not receive	358	33%					1	0.4%
How often do you use the BPP to make decisions on the type of food to consume?								
Never	109	10%	37	16%	39	15%	30	12%
Rarely	99	9%	27	11%	33	12%	38	15%
Sometimes	292	27%	89	38%	104	39%	97	39%
Often	226	21%	70	30%	81	30%	71	29%
Did not receive	358	33%			1	0.4%	1	0.4%
How often do you use the BPP to make decisions on the type of food to serve others?								
Never	113	10%	37	16%	41	15%	32	13%
Rarely	94	9%	27	11%	29	11%	37	15%
Sometimes	275	25%	83	35%	102	38%	88	36%
Often	245	22%	77	32%	85	32%	79	32%
Did not receive	358	33%					1	0.4%
How often do you use the BPP to make your own decisions about the amount of food to consume?								
Never	106	10%	35	15%	39	15%	29	12%
Rarely	96	9%	28	12%	29	11%	38	15%
Sometimes	280	26%	84	35%	100	37%	94	38%
Often	245	22%	76	32%	90	34%	75	30%
Did not receive	358	33%	1	0.4%			1	0.4%

Note: Never = not once in the last 4 weeks; rarely = 1-2 times in the last 4 weeks; sometimes = 3-4 times in the last 4 weeks; often = more than 10 times in the last 4 weeks

Table 3-4. Reason for noncompliance among participants who never use the BPP

	All treated		BPP only		BPP x nutrition education		BPP x nutrition and gender education	
	N	Percent	N	Percent	N	Percent	N	Percent
I do not have access to the items on the BPP	3	4%	1	5%	2	6%	--	--
I cannot afford the food items on the BPP	3	4%	1	5%	2	6%	--	--
I prefer to use other plates	46	60%	13	68%	21	66%	12	46%
I do not understand the BPP	1	1%	--	--	--	--	1	4%
I only use the BPP for guests	5	6%	1	5%	2	6%	2	8%

Note: participants could select more than one reason

Table 3-5. Estimated marginal effects from Poisson regression of treatments on 24 hour individual dietary diversity score (IDDS)[+]

VARIABLES	(1) IDDS	(2) IDDS
BPP only	-0.110	-0.043
	[0.549]	[0.241]
Nutrition education	-0.133	-0.029
	[0.331]	[0.295]
Nutrition education with gender	-0.066	0.221
	[0.225]	[0.193]
BPP x nutrition education	-0.040	-0.012
	[0.524]	[0.233]
BPP x nutrition education with gender	0.192	0.148
	[0.576]	[0.263]
Post	0.669	0.707*
	[0.424]	[0.406]
BPP x post	0.083	0.048
	[0.448]	[0.439]
Nutrition education x post	-0.165	-0.216
	[0.486]	[0.485]
Nutrition education with gender x post	-0.241	-0.276
	[0.462]	[0.451]
BPP x nutrition education x post	-0.154	-0.181
	[0.462]	[0.456]
BPP x nutrition education with gender x post	0.004	-0.047
	[0.471]	[0.462]
Mymensingh district		3.070***
		[0.138]
Gender (female = 1)		-0.136
		[0.193]
Age		0.005
		[0.005]
Primary school (highest level)		0.242**
		[0.121]
Junior secondary school (highest level)		0.418**
		[0.197]
Secondary school (highest level)		0.623***
		[0.207]
SSC pass (highest level)		0.509**
		[0.236]
Postsecondary education		0.498*
		[0.257]
Responsible for food preparation		0.280*
		[0.148]

Table 3-5. Continued.

VARIABLES	(1) IDDS	(2) IDDS
Total cultivable land (decimals)		0.001***
		[1.90E-04]
Farm diversity (count of food groups produced)		0.128***
		[0.038]
Number of observations	2,164	2,164
Log Likelihood	-5153	-4704

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 3-6. Logistic regression marginal effects results of treatment on 24 hour consumption of fruit and vegetable groups without covariates

Treatment	Vitamin A rich vegetables	Tubers and roots	Leafy green vegetables	Other vegetables	Vitamin A rich fruit	Other fruit
BPP only	-0.069*	0.017	-0.075	3.63E-05	0.001	0.025
	<0.041>	<0.061>	<0.061>	<0.101>	<0.051>	<0.061>
Nutrition education	0.017	0.062	-0.051	0.056	-0.008	-0.037
	<0.041>	<0.051>	<0.061>	<0.051>	<0.051>	<0.051>
Nutrition education with gender	-0.003	-0.107**	0.065	0.003	0.028	-0.039
	<0.041>	<0.051>	<0.081>	<0.051>	<0.051>	<0.041>
BPP x nutrition education	0.008	0.011	-0.124**	0.032	-0.011	-0.008
	<0.041>	<0.061>	<0.061>	<0.091>	<0.041>	<0.061>
BPP x nutrition education with gender	-0.011	0.017	-0.022	0.049	0.086	0.023
	<0.051>	<0.061>	<0.061>	<0.091>	<0.051>	<0.061>
Post	0.172***	-0.092*	-0.062	0.171***	0.119**	-0.061
	<0.051>	<0.051>	<0.081>	<0.061>	<0.051>	<0.071>
BPP x post	0.026	0.007	0.099	0.050	-0.035	-0.053
	<0.061>	<0.061>	<0.091>	<0.081>	<0.061>	<0.071>
Nutrition education x post	-0.122*	0.036	0.077	-0.051	-0.012	0.017
	<0.071>	<0.071>	<0.081>	<0.081>	<0.061>	<0.071>
Nutrition education with gender x post	-0.068	0.109*	-0.075	0.058	-0.091	0.012
	<0.071>	<0.061>	<0.111>	<0.071>	<0.061>	<0.091>
BPP x nutrition education x post	-0.070	0.031	0.161*	-0.058	-0.036	0.004
	<0.061>	<0.061>	<0.091>	<0.071>	<0.061>	<0.081>
BPP x nutrition education with gender x post	0.019	0.052	0.123	-0.034	-0.108**	0.003
	<0.071>	<0.061>	<0.091>	<0.071>	<0.061>	<0.081>
Covariates	No	No	No	No	No	No
Number of observations	2,164	2,164	2,161	2,164	2,164	2,164
Log Likelihood	-1197	-1237	-1442	-1411	-634.8	-1139

Note: Marginal effects are reported; Cluster-robust standard errors are in <> *** p<0.01, ** p<0.05, * p<0.1

Table 3-7. Logistic regression marginal effects results of treatment on 24 hour consumption of other food groups without covariates

Treatment	Meat	Eggs	Fish	Pulses	Dairy	Fats and oils	Sugar	Spices
BPP only	-0.090	0.018	-0.048	-0.017	0.041	-0.008	0.091	0.022
	<0.081>	<0.061>	<0.071>	<0.071>	<0.071>	<0.031>	<0.081>	<0.051>
Nutrition education	-0.010	0.046	-0.120***	0.017	-0.065	-0.029	0.012	0.012
	<0.071>	<0.051>	<0.041>	<0.061>	<0.061>	<0.021>	<0.081>	<0.041>
Nutrition education with gender	-0.039	0.051	0.023	-0.092*	0.001	0.037	0.022	0.029
	<0.071>	<0.061>	<0.051>	<0.051>	<0.051>	<0.041>	<0.071>	<0.041>
BPP x nutrition education	-0.087	0.049	-0.028	0.031	0.057	-0.027	0.102	0.003
	<0.071>	<0.061>	<0.071>	<0.071>	<0.061>	<0.031>	<0.081>	<0.051>
BPP x nutrition education with gender	-0.057	0.034	0.002	-0.020	0.068	-0.025	0.099	-0.001
	<0.081>	<0.071>	<0.071>	<0.071>	<0.071>	<0.031>	<0.081>	<0.051>
Post	-0.097	0.088	0.133**	0.018	0.066	0.058	0.145**	0.068
	<0.081>	<0.071>	<0.061>	<0.061>	<0.061>	<0.041>	<0.061>	<0.061>
BPP x post	0.052	0.051	-0.083	-0.051	-0.022	0.018	-0.049	0.063
	<0.091>	<0.081>	<0.071>	<0.071>	<0.071>	<0.051>	<0.061>	<0.081>
Nutrition education x post	0.024	-0.023	0.009	-0.082	0.010	0.058	-0.078	-0.060
	<0.081>	<0.081>	<0.071>	<0.071>	<0.081>	<0.071>	<0.111>	<0.081>
Nutrition education with gender x post	-0.024	-0.010	-0.126	0.063	-0.014	---	-0.097	-0.013
	<0.101>	<0.091>	<0.081>	<0.071>	<0.071>	---	<0.081>	<0.071>
BPP x nutrition education x post	-0.002	0.005	-0.080	-0.076	-0.053	0.004	-0.074	0.011
	<0.091>	<0.081>	<0.071>	<0.071>	<0.071>	<0.051>	<0.061>	<0.071>
BPP x nutrition education with gender x post	0.031	0.033	-0.136***	0.064	-0.031	0.010	-0.092	-0.003
	<0.091>	<0.081>	<0.081>	<0.071>	<0.061>	<0.051>	<0.071>	<0.081>
Covariates	No	No	No	No	No	No	No	No
Number of observations	2,164	2,164	2,164	2,164	2,164	2,035	2,164	2,164
Log Likelihood	-1297	-1257	-1165	-1491	-1122	-450	-1233	-1073

Note: Marginal effects are reported; Cluster-robust standard errors are in <> *** p<0.01, ** p<0.05, * p<0.1

Table 3-8. Logistic regression marginal effects results of treatment on 24 hour consumption of fruit and vegetable groups including covariates

Treatment	Vitamin A rich vegetables	Tubers and roots	Leafy green vegetables	Other vegetables	Vitamin A rich fruit	Other fruit
BPP only	-0.056	0.031	-0.052	0.003	0.009	0.049
	<0.051>	<0.051>	<0.061>	<0.047>	<0.041>	<0.044>
Nutrition education	0.024	0.068	-0.043	0.065*	0.001	-0.027
	<0.044>	<0.048>	<0.060>	<0.039>	<0.053>	<0.054>
Nutrition education with gender	0.015	-0.083*	0.088	0.040	0.045	-0.010
	<0.041>	<0.045>	<0.075>	<0.045>	<0.048>	<0.043>
BPP x nutrition education	0.017	0.021	-0.105*	0.032	-0.006	0.013
	<0.049>	<0.049>	<0.061>	<0.040>	<0.041>	<0.042>
BPP x nutrition education with gender	-0.011	0.020	-0.003	0.042	0.0816**	0.037
	<0.056>	<0.050>	<0.063>	<0.042>	<0.038>	<0.043>
Post	0.166***	-0.095**	-0.059	0.170***	0.118**	-0.053
	<0.049>	<0.047>	<0.082>	<0.059>	<0.048>	<0.062>
BPP x post	0.023	0.012	0.101	0.053	-0.036	-0.060
	<0.062>	<0.061>	<0.093>	<0.073>	<0.058>	<0.071>
Nutrition education x post	-0.127*	0.035	0.087	-0.052	-0.019	0.018
	<0.068>	<0.069>	<0.082>	<0.076>	<0.057>	<0.069>
Nutrition education with gender x post	-0.072	0.111*	-0.074	0.045	-0.094	0.011
	<0.066>	<0.067>	<0.108>	<0.070>	<0.064>	<0.085>
BPP x nutrition education x post	-0.066	0.033	0.163*	-0.055	-0.035	0.002
	<0.064>	<0.062>	<0.092>	<0.069>	<0.056>	<0.073>
BPP x nutrition education with gender x post	0.022	0.052	0.118	-0.034	-0.104*	-0.007
	<0.069>	<0.062>	<0.093>	<0.074>	<0.054>	<0.075>
Mymensingh district	0.172***	0.311***	0.175***	0.375***	0.176***	0.228***
	<0.028>	<0.027>	<0.032>	<0.025>	<0.024>	<0.036>

Table 3-8. Continued.

Treatment	Vitamin A rich vegetables	Tubers and roots	Leafy green vegetables	Other vegetables	Vitamin A rich fruit	Other fruit
Gender (female = 1)	-0.021	-0.036	0.053	-0.109**	0.024	0.0781**
	<0.049>	<0.041>	<0.045>	<0.053>	<0.024>	<0.037>
Age	0.001	-0.001	4.00E-04	-2.80E-04	0.001	0.001
	<0.001>	<0.001>	<0.001>	<0.001>	<0.001>	<0.001>
Primary school (highest level)	0.0571**	-0.022	-0.059**	0.004	0.0592***	-0.003
	<0.027>	<0.023>	<0.029>	<0.023>	<0.019>	<0.028>
Junior secondary school (highest level)	0.089**	-0.002	-0.040	-0.025	0.0695***	0.046
	<0.036>	<0.038>	<0.033>	<0.029>	<0.025>	<0.031>
Secondary school (highest level)	0.093**	-0.054	-0.047	0.038	0.0593***	0.063
	<0.040>	<0.043>	<0.040>	<0.041>	<0.022>	<0.043>
SSC pass (highest level)	0.075	-0.031	0.008	0.035	0.0558**	0.010
	<0.047>	<0.058>	<0.050>	<0.052>	<0.027>	<0.044>
Postsecondary education	0.077	-0.022	-0.018	-0.017	0.0677**	0.062
	<0.047>	<0.049>	<0.047>	<0.051>	<0.031>	<0.039>
Responsible for food preparation	0.053	0.080**	0.005	0.0692**	0.011	0.002
	<0.038>	<0.040>	<0.046>	<0.034>	<0.019>	<0.034>
Total cultivable land (decimals)	-0.001*	9.57E-05	-9.07E-06	2.65E-05	7.92e-05***	1.13E-04**
	<0.006>	<1.62E-04>	<7.29E-05>	<7.60E-05>	<2.43E-05>	<5.57E-05>
Farm diversity (count of food groups produced)	-0.001	0.006	0.005	0.001*	0.003	0.0176***
	<0.006>	<0.005>	<0.005>	<0.005>	<0.004>	<0.006>
Number of observations	2,161	2,161	2,161	2,161	2,161	2,161
Log Likelihood	-1149	-1071	-1442	-1088	-542.2	-1003

Note: Marginal effects are reported; Cluster-robust standard errors are in <> *** p<0.01, ** p<0.05, * p<0.1

Table 3-9. Logistic regression marginal effects results of treatment on 24 hour consumption of other food groups including covariates

Treatment	Meat	Eggs	Fish	Pulses	Dairy	Fats and oils	Sugar	Spices
BPP only	-0.099	0.041	-0.034	0.007	0.041	-0.001	0.041	-0.020
	<0.070>	<0.056>	<0.046>	<0.049>	<0.050>	<0.022>	<0.054>	<0.044>
Nutrition education	-4.27E-04	0.047	-0.112***	0.039	-0.043	-0.022	0.007	0.001
	<0.060>	<0.049>	<0.037>	<0.063>	<0.056>	<0.023>	<0.067>	<0.042>
Nutrition education with gender	-0.022	0.068	0.047	-0.053	0.029	0.045	0.033	0.014
	<0.062>	<0.061>	<0.048>	<0.052>	<0.051>	<0.035>	<0.064>	<0.038>
BPP x nutrition education	-0.101	0.069	-0.017	0.053	0.055	-0.021	0.049	-0.040
	<0.064>	<0.056>	<0.047>	<0.046>	<0.048>	<0.021>	<0.049>	<0.045>
BPP x nutrition education with gender	-0.072	0.047	0.009	-0.006	0.056	-0.020	0.040	-0.036
	<0.067>	<0.057>	<0.048>	<0.050>	<0.044>	<0.023>	<0.056>	<0.044>
Post	-0.090	0.093	0.130**	0.022	0.073	0.060	0.134***	0.072
	<0.077>	<0.068>	<0.059>	<0.058>	<0.052>	<0.037>	<0.051>	<0.061>
BPP x post	0.043	0.048	-0.078	-0.053	-0.024	0.015	-0.036	0.059
	<0.094>	<0.079>	<0.070>	<0.071>	<0.064>	<0.048>	<0.055>	<0.083>
Nutrition education x post	0.012	-0.019	0.019	-0.097	-0.007	0.053	-0.080	-0.057
	<0.076>	<0.081>	<0.067>	<0.066>	<0.074>	<0.067>	<0.102>	<0.080>
Nutrition education with gender x post	-0.033	-0.014	-0.122	0.061	-0.015	-	-0.094	-0.014
	<0.092>	<0.093>	<0.075>	<0.066>	<0.069>	--	<0.073>	<0.071>
BPP x nutrition education x post	-0.007	-0.002	-0.078	-0.076	-0.054	0.002	-0.066	0.007
	<0.090>	<0.079>	<0.071>	<0.065>	<0.064>	<0.044>	<0.060>	<0.073>
BPP x nutrition education with gender x post	0.022	0.029	-0.137*	0.057	-0.035	0.006	-0.080	-0.005
	<0.088>	<0.080>	<0.070>	<0.070>	<0.058>	<0.045>	<0.061>	<0.083>
Mymensingh district	0.145***	0.139***	0.301***	0.320***	0.263***	0.0743***	0.283***	-0.0732**
	<0.041>	<0.023>	<0.031>	<0.025>	<0.024>	<0.022>	<0.028>	<0.035>

Table 3-9. Continued.

Treatment	Meat	Eggs	Fish	Pulses	Dairy	Fats and oils	Sugar	Spices
Gender (female = 1)	-0.010	0.0751*	-0.022	0.061	0.037	0.011	-0.115***	-0.152***
	<0.043>	<0.039>	<0.041>	<0.045>	<0.036>	<0.020>	<0.041>	<0.037>
Age	0.00184**	-0.001	-1.95E-04	-4.21E-04	0.00186**	4.85E-04	0.001	3.36E-04
	<0.001>	<0.001>	<0.001>	<0.001>	<0.001>	<4.45E-04>	<0.001>	<0.001>
Primary school (highest level)	0.0445**	0.010	-0.014	0.004	0.0944***	0.002	0.0674**	0.014
	<0.022>	<0.028>	<0.020>	<0.028>	<0.022>	<0.011>	<0.030>	<0.021>
	0.0693**	-0.007	-0.020	0.040	0.104***	0.017	0.070	-0.009
Junior secondary school (highest level)	<0.034>	<0.034>	<0.033>	<0.036>	<0.025>	<0.021>	<0.043>	<0.035>
Secondary school (highest level)	0.101***	-0.001	-0.010	0.017	0.149***	0.009	0.108**	0.052
	<0.038>	<0.044>	<0.041>	<0.053>	<0.029>	<0.028>	<0.050>	<0.056>
SSC pass (highest level)	0.060	0.033	0.029	0.0774*	0.0870***	-0.031	0.0614*	0.064
	<0.038>	<0.069>	<0.064>	<0.042>	<0.033>	<0.025>	<0.034>	<0.046>
Postsecondary education	0.167***	0.035	-0.111**	0.025	0.057	0.034	0.067	0.013
	<0.042>	<0.051>	<0.050>	<0.053>	<0.038>	<0.028>	<0.048>	<0.041>
Responsible for food preparation	0.012	0.008	0.021	-0.045	0.005	0.005	0.039	0.004
	<0.044>	<0.035>	<0.036>	<0.035>	<0.030>	<0.015>	<0.038>	<0.033>
Total cultivable land (decimals)	2.41E-04***	9.71e-05**	-1.86E-05	-9.84E-06	1.35E-04**	1.25E-06	2.40E-04***	3.25E-05
	<7.53E-05>	<4.37E-05>	<5.61E-05>	<7.34E-05>	<6.09E-05>	<3.60E-05>	<7.54E-05>	<8.77E-05>
Farm diversity (count of food groups produced)	0.009	0.010	0.0108**	0.0107*	0.0270***	0.00569*	0.005	0.0124**
	<0.007>	<0.007>	<0.005>	<0.006>	<0.005>	<0.003>	<0.006>	<0.005>
Number of observations	2,161	2,161	2,161	2,161	2,161	2,032	2,161	2,161
Log Likelihood	-1201	-1215	-944	-1313	-903	-418	-986	-1038

Note: Marginal effects are reported; Cluster-robust standard errors are in <> *** p<0.01, ** p<0.05, * p<0.1

Table 3-10. Estimated treatment effects on 7-day food consumption score (FCS)

VARIABLES	(1) FCS	(2) FCS
BPP only	-0.296	0.328
	[3.879]	[1.635]
Nutrition education	-1.666	-0.685
	[1.658]	[1.482]
Nutrition education with gender	-2.116	-0.182
	[1.463]	[1.312]
BPP x nutrition education	0.599	0.876
	[3.660]	[1.491]
BPP x nutrition education with gender	1.376	1.519
	[3.755]	[1.600]
Post	0.175	0.680
	[1.597]	[1.461]
BPP x post	3.500*	3.234*
	[1.950]	[1.810]
Nutrition education x post	3.454	2.690
	[2.279]	[2.237]
Nutrition education with gender x post	3.412**	3.077*
	[1.669]	[1.717]
BPP x nutrition education x post	3.678*	3.384*
	[2.049]	[1.850]
BPP x nutrition education with gender x post	3.217	2.540
	[2.052]	[1.924]
Mymensingh district		18.914***
		[0.867]
Gender (female = 1)		-0.136
		[1.169]
Age		0.013
		[0.029]
Primary school (highest level)		0.333
		[0.808]
Junior secondary school (highest level)		3.151***
		[1.097]
Secondary school (highest level)		4.955***
		[1.360]
SSC pass (highest level)		1.976
		[1.284]
Postsecondary education		4.133***
		[1.266]
Responsible for food preparation		1.977*
		[1.078]

Table 3-10. Continued.

VARIABLES	(1) IDDS	(2) IDDS
Total cultivable land (decimals)		0.006**
		[0.002]
Farm diversity (count of food groups produced)		1.818***
		[0.153]
Constant	67.719***	47.669***
	[2.710]	[2.787]
Number of observations	2,130	2,127
R-squared	0.014	0.523

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

CHAPTER 4
MARKET ACCESS AND NUTRITION-SENSITIVE AGRICULTURE: A CONCEPTUAL FRAMEWORK AND EMPIRICAL FINDINGS

Background

Despite progress in recent years, 795 million people in the world are classified as undernourished, or unable to meet the dietary energy requirements for a healthy and active life (FAO, IFAD, and WFP, 2015). Micronutrient deficiencies due to low dietary quality, often called "hidden hunger," are even more prevalent (FAO, IFAD, and WFP, 2015). In the developing world, 40% of the population lacks sufficient iron in their diet, and over one in three children suffer from vitamin A deficiencies (World Bank, 2006). Improving dietary diversity by consuming a wider variety of food groups can lead to improved nutrition by increasing the intake of micronutrients such as vitamin A and iron (Arimond and Ruel, 2004; Hatloy et al., 1998; Torheim et al., 2004). To encourage the consumption of a larger variety of food groups, many development initiatives promote the adoption of new technologies or practices to improve agricultural production. The linkages between agriculture and nutrition can be identified as two farm-based pathways towards improved nutrition: 1) increasing income through the sale of agricultural products, thus allowing for the purchase of more diverse foods, and 2) household consumption of food produced on the farm (Carletto, 2015; Chung, 2012).

There may be a tendency to think of these farm-based pathways as mutually exclusive, where some households engage in commercial agriculture and others operate at subsistence farming levels. In reality, many smallholder farmers are faced with the decision to sell or to consume each product they produce. Oftentimes households supplement farm revenue with off-farm income, and the earnings from off-farm labor may be used to purchase food from the market. Thus, while farm production may impact nutrition decisions, the household's access to markets for selling products, buying food, and earning off-farm labor should also be considered.

Recent empirical studies show a positive relationship between farm production diversity and household dietary diversity (Dillon et al., 2015; Jones et al., 2014; Keding et al., 2012; Kumar et al., 2015). Livestock production is also associated with higher consumption of animal source foods, thus increasing household dietary diversity (Azzari et al., 2015; Rawlins et al., 2014). However, few of these studies consider the role of market access on production and consumption decisions (Sibhatu et al., 2015). Jones et al. (2014) includes an indicator to account for whether the household is market-oriented or engages in subsistence farming. The indicator is measured as the proportion of food consumed in the previous week sourced from own production. The results suggest that farm households who are more market-oriented have higher dietary diversity. Chege et al. (2014) find farm household participation in supermarket contracts leads to an increase in nutrient intake for vitamin A, iron, and zinc due to increases in income and household vegetable production.

In a multi-country analysis, Sibhatu et al. (2015) find access to agricultural markets positively impacts household dietary diversity, even more so than production diversity. The study finds household diets are more diverse among farmers who produce commercial cash crops compared to subsistence farmers who produce a larger variety of products. The authors suggest that encouraging farm diversity is not always the solution to improving dietary diversity, and efforts to improve market access may be a better investment.

This essay expands on the previous literature to investigate the relationship between agricultural production, household dietary diversity, and access to markets. First we present a theoretical framework to formalize the pathways from agriculture to nutrition. Barnum and Squire's (1979) agricultural household model is expanded to include market participation and nutrition. An empirical analysis of household-level survey data then follows to investigate the

effects of market participation and farm diversity on the decisions to produce and consume a variety of food groups in rural Bangladesh. The results suggest households with greater levels of participation in buyers' markets consume more micronutrient-rich foods. Participation in markets for selling agricultural products increases farm diversity but decreases dietary diversity. Further investigation is needed to determine whether households are diversifying production and selling high-value items such as fruits and vegetables in order to purchase more staple food items, namely rice.

Food Insecurity in Bangladesh

Rural areas in Bangladesh are particularly prone to undernourishment and insufficient dietary quality (Ahmed et al., 2013). In a nationally representative study, 35.5% of rural households are food-energy deficient, meaning they cannot afford an adequate diet to meet daily energy requirements (Ahmed et al., 2013). Rural households spend the highest share of their total budget, 60%, on food expenditures (Ahmed et al., 2013). On average, Bangladeshi households spend 20% to 50% of their total food budget on rice, depending on income, and no other food item accounts for more than 10% of the food budget (Ahmed et al., 2013). The primary strategy for achieving food security in Bangladesh is self-sufficiency in rice production. With investments in agricultural technology and irrigation, the country has largely achieved this goal. Rice accounts for 77% of total cropped area, yet micronutrient deficiencies persist due to the infrequent consumption of other food items such as fruit, vegetables, and meat (Ahmed et al., 2013). The dietary imbalance is worse for the poorest members of society and is driven by a lack of production diversity, income constraints, strong individual food preferences, and a lack of nutrition knowledge (Hossain et al., 2005). In addition to a nutrition-poverty trap, a gendered nutrition gap exists in Bangladesh, where women's nutrient consumption is one and a half times lower than men's nutrient consumption (Hossain et al., 2005). Rashid et al. (2011) find lower

dietary diversity and protein availability among female-headed households than male-headed households, and they go on to suggest that female-headed households are at a dietary disadvantage due to the limited mobility of women in Bangladesh. Typically, male family members go to the market, where they can access diverse foods. Female-headed households may not have adult male members, and may lack access to markets as a result.

This paper aims to understand the means through which production diversity and market participation affect household consumption of protein, fruits, and vegetables in Bangladesh. Specifically, we explore household decisions to participate in markets for purchasing or selling nutrient-rich foods. Under perfect market conditions, an agricultural household would be indifferent between purchasing food at the market versus consuming food produced at home. The price of food from either source, purchased or produced, would be equal after accounting for the transaction costs associated with buying or selling the food item. In this case, a household would separately consider consumption decisions to maximize utility and production decisions to maximize profits. When market imperfections exist, however, the consumption and production models are no longer separable (Muller, 2009; Singh et al., 1986). Rather, the household makes simultaneous production and consumption decisions to maximize utility subject to a production function as well as time and income constraints.

Nutrition, Markets and the Agricultural Household Model

The nonseparable model where households jointly consider consumption and production decisions is referred to as the agricultural household model (Barnum and Squire, 1979; Singh et al., 1986) and builds on the household production model of Becker (1965). Based on the framework for health and nutrition developed by Behrman and Deolalikar (1988), we expand the agricultural household model so that household utility is not only a function of the goods and leisure consumed by the household, but also the health of its members. Nutrition is an input to

health delivered through the consumption of food items, which contain a combination of macronutrients (carbohydrates, fats, and proteins) and micronutrients (vitamins and minerals). To expand the agricultural household model such that it includes nutrition, we consider all goods, whether purchased or produced, to be a function of nutrients, **N**, and other attributes, $\boldsymbol{\alpha}$. Thus, a good with positive nutrient content, N>0, is a food item, whereas a product with zero nutrient content (N = 0) is a non-food item. Combining the models used by Barnum and Squire (1979) and Behrman and Deolalikar (1988), households maximize the utility function in Equation (4-1) subject to constraints in Equations (4-2) through (4-4). Equations (4-5) through (4-9) define the variables of interest.

$$Max\, U = U\left(H\left(.\right), C\left(.\right), \ell, \mu\right) \tag{4-1}$$

$$s.t.\ F_j = F_j\left(X, L_f\right)\ \ \forall\, j \tag{4-2}$$

$$T = L_f + L_w + \ell \tag{4-3}$$

$$\sum_{j=1}^{J} I_j^B q_j M_j = \sum_{j=1}^{J} I_j^S p_j M_j + wL_w - X'p_x \tag{4-4}$$

$$where\ \ H = H\left(C\left(.\right), \eta\right) \tag{4-5}$$

$$C_j = C_j\left(N, \alpha\right)\ \forall\, j \tag{4-6}$$

$$I_j^Y = \begin{Bmatrix} I_j^B = 1\ \ if\left(F_j - C_j\right) < 0,\ 0\, otherwise \\ I_j^S = 1\ \ if\left(F_j - C_j\right) > 0,\ 0\, otherwise \\ I_j^A = 1\ \ if\left(F_j - C_j\right) = 0,\ 0\, otherwise \end{Bmatrix}\ \forall\, j \tag{4-7}$$

$$M_j = F_j - C_j \tag{4-8}$$

$$\left(q_j - p_j\right) = \tau_j\left(A, G, W, M_j, V, \Omega\right) \tag{4-9}$$

In Equation (4-1), household utility, $U(.)$, is a function of household health, $H(.)$, consumed goods and services, $C(.)$, that are produced at home or purchased from the market, leisure time consumed by the household, ℓ, and other household characteristics and preferences, μ. Household health, $H(.)$, is a function of the nutrients and attributes consumed through goods and services produced at home or purchased from the market, $C(.)$, and household characteristics that affect health, η, such as dwelling conditions, sanitation, or genetic endowment of family members. The consumption of goods and services that affect health include food items as well as non-food items such as medicines, immunizations, and doctor visits.

Food and non-food items can affect health positively or negatively, depending on the good. For example, consuming sugary foods or cigarettes negatively impacts health, while consuming leafy green vegetables or proper doses of medicine has positive health benefits. As shown in Equation (4-6), each good is a function of its nutrients, **N**, and other attributes, α.

For any item *j* produced at home, there is a unique production function, F_j, which maps a set of inputs to outputs for that good (Equation (4-2)). The inputs, X, required to produce output *j* include variable inputs such as seed or fertilizer, and quasi-fixed assets such as land and capital. The production of good *j* also depends on labor, L_f, which includes the unpaid labor of family members working on the farm and hired labor. Following the original design of the agricultural household model in Barnum and Squire (1979), Equation (4-3) indicates that a household is a net seller or net buyer of time, *T*, based on household labor allocation. Time, *T*, is the sum of total labor used in the production of household goods, L_f, wage labor, L_w, and leisure ℓ. L_f includes

hired labor as well as unpaid time of the family members allocated to own production. L_w reflects net changes to total labor that arise as a household buys and sells labor. If $L_w < 0$ then wage labor is hired and external workers contribute to household production. If $L_w > 0$ then wage labor is sold and family members earn wages for off-farm labor. As noted in Equation (4-1), utility is a function of leisure, ℓ, consumed, which is the difference between time, *T*, and labor, $\left(L_f + L_w\right)$.

A household can be a net seller or a net buyer of any good based on the difference between household production and consumption of that item. Based on the household surplus or shortage of a good, the household will enter the market to sell or buy good *j*. Equation (4-7) defines I_j^γ as an indicator for market participation. A household whose optimal decision includes participation in the market for selling good *j* will produce a surplus, $\left(F_j - C_j\right) > 0$. As the household enters the market for selling, I_j^S is equal to 1, indicating participation in the sellers market. A household facing a shortage, $\left(F_j - C_j\right) < 0$, will enter the market for buying good *j*, and I_j^B equal to 1 indicates participation in the buyers' market. For a household in autarky, $\left(F_j - C_j\right) = 0$, who neither sells nor buys item *j* in the market, I_j^S and I_j^B are equal to zero, indicating no market participation. Per Equation (4-8), M_j is defined as the quantity of units sold or bought in the market.

Following Barrett (2008), we assume the household faces different prices, q_j or p_j for good *j* depending on whether the good is purchased in the market or sold in the market,

respectively. Equation (4-9) shows the difference in price $\left(q_j - p_j\right)$ and reflects the transaction costs, τ_j associated with market participation to buy or sell good *j*. The transaction costs depend on the household's access to assets, *A* (i.e. land, labor, capital), public services, *G*, such as roads and extension services, and off-farm income, *W* (Barrett, 2008). The transaction costs for a commodity vary depending on the scope of market transactions, M_j, the presence of intermediaries along the value chain for good *j*, such as traders and brokers, and a set of household-specific characteristics, Ω, such as gender, education, and social status of the head of household and other factors that affect the decision-maker's search costs and ability to participate in markets. Under perfect market conditions, there would be no difference in the buying and selling price, p_j would be equal to q_j, and the household utility model would be separable. However, this is rarely the case in a developing country such as Bangladesh. Households face a variety of market failures such as a lack of infrastructure, information asymmetries, and restricted access to markets based on cultural norms such as gender roles. Thus, consumption and production decisions among rural households in Bangladesh are nonseparable.

To model this, the household maximizes utility subject to the full income constraint in Equation (4-4). The left hand side of Equation (4-4) includes the total cost for M_j units of all goods and services, *j*, purchased in the market at price q_j. As defined above, I_j^B indicates participation in the market for buying goods. $I_j^B = 0$ when a household does not purchase good *j* from the market. The right hand side of Equation (4-4) reflects the total income of the household as the sum of wages earned off-farm plus profits earned from agricultural production. Wages, *w*,

can positively or negatively contribute to income depending on whether the household is a net seller ($L_w > 0$) or net buyer ($L_w < 0$) of labor. Agricultural profits are calculated as farm revenue minus production costs. Farm revenue is calculated as the product of p_j, the price of item *j*, M_j, the quantity of marketable surplus, and I_j^S, which indicates participation in the sellers market for item *j*. when sold in the market. Production costs are calculated based on the wage of hired labor, *w*, and the cost of inputs used for production, p_x. A household in autarky $I_j^A = 1$ neither buys nor sells product *j* in the market, but consumes all units of the good produced at home; thus the price of an autarkic good is equal to the production costs.

To optimize production and consumption decisions in this non-separable agricultural household model, we maximize Equation (4-1) subject to constraints in Equations (4-2) through (4-4) using the following Lagrangian function:

$$\mathcal{L} = U\left(C, H, \ell, \mu\right) + \lambda\left[I_j^S p_j M_j + wL_w - X'p_x - I_j^B q_j M_j\right] \tag{4-10}$$

We can further define the Langrangian by substitution,

$$\mathcal{L} = U\left(C, H, \ell, \mu\right) + \lambda\left[I_j^S p_j (F_j - C_j) + w(T - \ell - L_f) - X'p_x - I_j^B q_j (F_j - C_j)\right] \tag{4-11}$$

The choice variables in this model include the optimal bundle of goods and services consumed, C_j, leisure, ℓ, and the optimal allocation of productive resources including total labor input, L_f, net quantity of labor sold, L_w, and inputs, X, used in production, F_j. Thus, the first order conditions are:

$$\frac{\partial \mathcal{L}}{\partial C} = \frac{\partial U}{\partial C} + \frac{\partial U}{\partial H} * \frac{\partial H}{\partial C} - \lambda\left[I_j^S * p_j - I_j^B * q_j\right] = 0 \tag{4-12}$$

$$\frac{\partial \mathcal{L}}{\partial \ell} = \frac{\partial U}{\partial \ell} - \lambda * w = 0 \tag{4-13}$$

$$\frac{\partial \mathcal{L}}{\partial L_f} = \lambda \left[I_j^S * p_j * \frac{\partial F}{\partial L_f} - w - I_j^B * q_j * \frac{\partial F}{\partial L_f} \right] = 0 \tag{4-14}$$

$$\frac{\partial \mathcal{L}}{\partial X_i} = \lambda \left[I_j^S * p_j * \frac{\partial F}{\partial X_i} - p_x - I_j^B * q_j * \frac{\partial F}{\partial X} \right] = 0 \tag{4-15}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = I_j^S * p_j * \left(F_j - C_j\right) + w * \left(T - \ell - L_f\right) - X' * p_X - I_j^B * q_j * \left(F_j - C_j\right) = 0 \tag{4-16}$$

The demand equations for the consumption of goods and services produced at home or purchased from the market can be found by simultaneously solving Equations (4-11) to (4-15). The consumption of goods and services is a function of market participation, I_j^γ. We are particularly interested in the demands for specific food items that are high in vitamin A, protein, and iron content and how the demands for these items are impacted by production decisions and market participation.

To analyze the relationship between agricultural production, nutrition and market participation, we can use the consumption of different food groups as a proxy for nutrient demand. According to the FAO Guidelines for Measuring Household and Individual Dietary Diversity, all food items can be categorized into one of fifteen food groups based on nutrient content (Kennedy et al., 2010). Table 4-1 shows the fifteen food group categories and examples of Bengali food in the context of our study. The sum of the number of food groups consumed by household members is known as the household dietary diversity score (HDDS). The HDDS measures the variety of food items consumed by an individual over a given period of time, usually 24 hours (Kennedy et al. 2010). Following the above theoretical model, dietary diversity is derived from a series of decisions optimizing the production and consumption of a variety of

nutrients. Our model suggests dietary diversity is a function of market participation and input decisions that ultimately lead to the household production of food. The following empirical analysis investigates how production decisions affect nutrient intake and the role of market participation in those decisions.

Methodology

The empirical methodology in this paper builds on the model used by Sibhatu et al. (2015) to investigate the role of market access in household nutrition. We first estimate thirteen logit models using production of the food groups in Table 4-1 as the dependent variable. Production of a food group is a binary variable equal to 1 if, in the last 12 months, the household produced any commodity best classified by that particular food group. The production of sugar and spices is not prevalent in our study area, thus the two food groups are omitted from the analysis on production. We then estimate fifteen logit models using consumption of the food groups in Table 4-1 as the dependent variables. Specifically, consumption is a binary variable equal to 1 if anyone in the household consumed that particular food group and 0 otherwise. We are particularly interested in the associations between agricultural production diversity, market participation, and the consumption of different food groups. To measure market participation we include a vector $\boldsymbol{I}$, of binary variables indicating whether or not a household participates in markets for selling agricultural products (commercial agricultural products, fruits and vegetables, fish, meat, eggs, dairy) and markets for buying food (all food items).

The general form of the model is:

$$N_{ij} = \alpha_0 + \beta_1 I_i + \mu_i' \beta_2 + \varepsilon_i \tag{4-17}$$

$$\textit{where} \begin{Bmatrix} N_{ij} = 1 \ \textit{if household i produces or consumes item j} \\ N_{ij} = 0 \ \textit{otherwise} \end{Bmatrix}$$

Where N_{ij} is a binary variable indicating household production (or consumption) of food group *j*. I is a vector of market participation variables for household *i*, and μ_i is a vector of farm and household characteristics. Specifically, μ_i includes a continuous variable for farm size, measured by the total decimals of cultivable land available and other household characteristics such as district, household size, religion of the household, age of the household head, gender of the household head, education of the household head, poverty score, and household food insecurity access score. District is a categorical variable indicating the district in which the household is located. Household size is the count of all household members. A household member is defined as anyone who habitually eats and sleeps in the home, including those who have been absent less than six months and have not established another residence. Religion of the household is an indicator variable equal to 1 for Muslim and 0 for non-Muslim. In Bangladesh, non-Muslim households are predominantly Hindu. Age of the head of household is a continuous variable. Education is a set of categorical variables taking a value of 1 for the highest level of education completed by the household head (none, primary, secondary, junior secondary, higher secondary, vocational, bachelor of science, post-graduate, professional) where completion of no education is the omitted variable. Gender of the household head is an indicator variable equal to 1 if the household head is female and 0 otherwise. The poverty score is calculated by weighting responses for a set of simple poverty scorecard questions for Bangladesh, following Schreiner (2013). The poverty score, ranging 0 to 100, indicates the likelihood that household expenditures are below the national poverty line where households with a score of 0 are most likely to fall below the poverty line. The household food insecurity access score (HFIAS) is a continuous variable measuring the degree of food insecurity in the household in the last 30 days. The score is calculated based on household responses to a number of questions about food vulnerability and

responses to a lack of access to food in the last 30 days. A higher score [0,27] indicates that the household is more food insecure (Coates et al., 2007).

Equation (4-17) models the production as well as the consumption of each food group. The production and consumption models include market participation and all other characteristics defined above. However, to the consumption models we also add farm diversity as an explanatory variable to investigate the relationship between production and consumption decisions. Farm diversity is measured as the count of food groups produced by the household in the last year [0,13].

In addition to the production and consumption of specific food groups, we are interested in the effect of market participation on farm diversity and dietary diversity. Thus, we also estimate Equation (4-17) using the farm diversity score and the household dietary diversity score (HDDS) as our dependent variables. In this case, farm diversity score is the number of food groups [0,13] produced in the last year. HDDS is the number of food groups consumed in the last 24 hours. The diversity models are estimated using Poisson regression since the dependent variables are count variables. The HDDS model includes a binary variable indicating whether or not the individual is the primary person responsible for preparing food for the household. Otherwise, the covariates for the farm diversity and household dietary diversity models remain the same as the logit regressions described above. The data in our analysis comes from a clustered sample of communities where our partner agencies serve. To account for this sampling strategy, the standard errors in each model are clustered at the community level.

Data Collection

The data for this analysis comes from a survey of 1,130 households in the Mymensingh and Borguna districts of Bangladesh. Mymensingh is a predominantly agricultural district located in northern Bangladesh, in the Dhaka division (Bangladesh Bureau of Statistics, 2013).

Agriculture accounts for 59.15% of landholdings in Mymensingh (Bangladesh Bureau of Statistics, 2013). Rice, jute, and sugarcane are among the main cash crops and jackfruit, banana and pineapple are the main fruits produced in the Mymensingh district (Bangladesh Bureau of Statistics, 2013). Borguna is a coastal district in southern Bangladesh in the Barisal division, bordering the Bay of Bengal. Of the total landholdings in Borguna district, 71.93% include agricultural land (Bangladesh Bureau of Statistics, 2013). Rice and pulses are among the main crops produced in Borguna, and the main fruits include coconut and banana (Bangladesh Bureau of Statistics, 2013).

The survey of rural households was conducted from August to November 2016. This project is part of a larger study funded by the USAID initiative "Integrating Gender and Nutrition in Agricultural Extension Services" (INGENAES) where we partnered with two institutions providing agricultural extension services: the Bangladesh Agricultural University Extension Center (BAUEC) and Shushilan, a local NGO. The survey participants were randomly selected from the membership lists of the two organizations in Mymensingh and Borguna, respectively. Shushilan is a national organization; however, for the purpose of this research we only engaged beneficiaries from the "Managing Natural Resources by the Coastal Community" (MaNaR) project. BAUEC serves male and female farmers in 20 unions of the Mymensing sadar upazila[1]. The membership is 55% male and 45% female. The MaNaR project primarily targets female beneficiaries, thus its membership is 94% female and 5% male. The Shushilan MaNar project area serves three unions in the Amtali upazila. Our survey sample included participants from 18 Shushilan communities and 35 BAUEC communities.

[1] An upazila is equivalent to a county-level administrative area; a union is the sub-county level comprised of a cluster of villages

The survey contained a household roster with demographics, simple poverty scorecard, agricultural production information (area planted and amount harvested, sold, kept for home consumption for each crop), household dietary diversity (24-hour food frequency, 7-day food frequency, and source of food items), nutrition knowledge, market access, and household food insecurity access score questions.

The sample includes 595 respondents from Mymensingh and 537 respondents from Borguna. In Mymensingh, 94% of the respondents live in male-headed households and 6% female-headed. However, in Borguna, 75% of the respondents reported female-headed households and 25% male-headed. The gendered differences in the sample reflect the membership of the partner organizations in the respective districts. Overall, we have a relatively large sample of female-headed households, 15%, compared to the national average of 12.5% (World Bank, 2016b).

Table 4-2 presents the descriptive statistics for the farm and household characteristics of the total sample and by district. Within our sample, 36% of household heads have not completed any education and 33% of household heads have completed some primary school (class 1 to 6). The majority of households in Bangladesh identify Muslim as their religion (89.1%), followed by Hindu (Bangladesh Bureau of Statistics, 2013). Our sample has a slightly higher representation, 95%, of Muslim households. The average household size of our sample is 4.6 persons, consistent with the national average of 4.5 (Bangladesh Bureau of Statistics, 2013).

According to the scorecard conversion table in Schreiner (2013), the mean poverty score of 48 indicates that 33.5% of our sample is below the daily per capita expenditure poverty threshold of US$1.25/day and there is a 19.6% likelihood that a household falls below the upper

national poverty line of BDT[2] 52.64 per person per day. Indicators for agricultural production in this study include total access to cultivable land (in decimals) and the count of all crops and livestock. Cultivable land includes cropped land as well as fallow land, but excludes all dwelling and homestead land (Schreiner, 2013). The land may be owned, sharecropped, or rented. On average, our sample households have access to 73 decimals, or 0.73 acres, of cultivable land and produce three crops and animal source foods.

To measure the level of participation in the buyer's market, respondents were asked "Did anyone in your household buy any food (from a market) to cook in the household in the last year?" For a variety of products (commercial agricultural products, vegetables and fruits, fish, meat, eggs, and milk) respondents were also asked if they sell each of these products (at home, via a trader, or at the market). In our analysis, selling food is treated as a binary variable equal to 1 if the household sold any food products and 0 otherwise. Table 4-2 shows evidence of agricultural sales varying by district, which may suggest a difference in access to markets between districts. We further investigate the role of market participation in our logit models. The results are presented in the next section.

Table 4-3 shows the mean and standard deviation of all dependent variables. The consumption of each food group is a binary variable equal to one if, in the last 24 hours, the respondent or anyone in the household consumed a food item that is categorized as that food group. As one would expect, cereal is the most frequently consumed food group. Ninety percent of households in our sample consumed cereals, namely rice, 24 hours prior to our survey. Vitamin A rich vegetables and fruits are among the lowest food groups consumed. Fish and pulses are the most frequently consumed sources of protein.

[2] US $1 is approximately 78 BDT

The production of each food group is a binary variable equal to one if, in the last 12 months, the household has produced a commodity with nutrients that most reflect that food group classification. Sixty-three percent of our sample produces rice, whereas almost 90% of households in our sample produce vegetables (such as gourds), fruits (such as bananas), and dairy products (cow or goat milk).

Regression Results

The results from the logit regressions for household production and consumption of each of the food groups are presented as odds ratios in Tables A-8 and A-9, respectively. The results in Table A-8 show that households living in Mymensingh, in northern Bangladesh, are more likely to produce several food groups. Given the difference in soil fertility and climate it is not surprising that district affects the decision to produce food crops. The correlation between district and production diversity is perhaps due to the suitable climate for producing fruits and vegetables in Mymensingh. Borguna, on the other hand, is located near the Bay of Bengal and is one of the areas most affected by climate change (Bangladesh Bureau of Statistics, 2013). Landholdings also impact production decisions. Households with access to more cultivable land are more likely to produce all vegetable classifications, vitamin A rich fruit, pulses, dairy, and oilseeds.

The results in Table A-8 indicate that the age and education of the household head also impacts the decision-making process for food production. Households headed by older individuals are more likely to produce white roots and tubers, other vegetables, fish, and pulses. If the household head passed the national SSC exam, the household is twice as likely to produce vitamin A rich fruits, fish, and other vegetables compared to households whose heads have no education. Interestingly, larger households are more likely to produce animal source foods (eggs, fish, and dairy), which may reflect the labor-intense nature of fish and livestock.

Poverty and household food insecurity also appear to be correlated with the production of certain types of food. Households with a higher poverty score–those less likely to fall below the poverty line–are less likely to produce cereals. It is possible that more impoverished households are producing cereals for home consumption. We see a positive correlation between households with a higher poverty score and the likelihood of producing vitamin A rich fruit and fish. Households with higher food insecurity, indicated by the HFIAS, are less likely to produce several nutrient-rich food groups.

Overall, participation in the market for purchasing food does not have a statistically significant correlation with farm diversity. However, households who participate in buyers' markets are less likely to produce oilseeds–presumably because fats and oils require a great deal of processing and the items are readily available in the market. As one would expect, the likelihood that a household produces items in nearly all food groups is higher if the household participates in markets for selling food products.

Similar to the production results, Table A-9 shows that district is a statistically significant predictor of the likelihood that a food group is consumed within the household. Following intuition, the results of the logit regressions suggest a higher household food insecurity access score (HFIAS) reduces the likelihood of consuming many of the analyzed food groups, particularly those high in micronutrients such as vitamin A and protein. The HFIAS measures hunger as well as access to food. In several cases, farm diversity (the count of food groups produced by the household) increases the likelihood that a food group is consumed. For five of the fifteen food groups, buying food from the market significantly impacts the consumption of that food group. Households who buy food from the market are nearly 3 times more likely to consume cereals, namely rice, and vegetables (e.g. gourds, tomatoes, etc.) than households that

do not buy food from the market. The likelihood of consuming eggs, dairy products, and sugar is also higher among households who purchase food from the market. On the contrary, households who sell products at the market are less likely to consume leafy green vegetables, other vegetables, fruit, oilseeds, sugar, and spices.

Tables 4-4 and 4-5 present the marginal effects from Poisson regressions on the farm diversity score and household dietary diversity score, respectively. Coefficient estimates from the Poisson regressions can be found in Tables A-10 and A-11. The results for the pooled model in Table 4-4 show households in Mymensingh produce 1.6 more food groups on average than households in Borguna. Households where the head passed the SSC exam produce 0.4 more food groups on average than households headed by an individual with no education. Disaggregating the data by district shows households headed by an individual who passed the SSC exam in Borguna are more specialized, producing 1.1 fewer food groups on average compared to households where the household head has no education. Household size and age of the household head are positively correlated with the average number of food groups produced in Mymensingh but not Borguna.

Access to one additional decimal of cultivable land results in 0.004 more food groups produced on average. Contrary to economic theory, which suggests access to markets would promote specialization, our results suggest selling food at the market is associated with higher farm diversity. A household who participates in markets for selling products produces 1.1 additional food groups on average compared to households that do not sell commodities.

District is also a statistically significant predictor of household dietary diversity, as shown in Table 4-5. Results from the pooled regression show that households in Mymensingh consume almost three additional food groups on average compared to Borguna. The findings

reveal a positive correlation between farm diversity and household dietary diversity. A household that produces one additional food group consumes 0.28 additional food groups on average. Conversely, households that sell agricultural products at the market consume 0.5 fewer food groups on average compared to households who do not participate in markets for selling products. Purchasing food at the market has no statistically significant effect on household dietary diversity.

Discussion

To formalize the theoretical framework linking agriculture and nutrition, this paper expands Barnum and Squire's (1979) agricultural household model. Our framework contributes to the existing literature by including not only nutrition but also transaction costs associated with market participation in the model. Using household survey data from two districts of Bangladesh, we then empirically investigate the relationships between market participation, household production, and consumption decisions for a variety of food groups.

The results suggest that market participation indeed influences household decisions surrounding the production and consumption of different food groups. Some ambiguity surrounds the net result of market participation, however. Contrary to the theory of specialization, households who engage in markets for selling agricultural products produce a larger variety of farm products. At the same time, participation in sellers' markets is correlated with a lower household dietary diversity score on average. Participation in sellers' markets may, therefore, incentivize households to produce and sell higher value, nutritious food items such as fruits and vegetables in order to purchase more staple crops such as rice. The analysis on the consumption of food groups, however, shows that participation in buyers' markets is positively correlated with dietary diversity. Consistent with expectations, households with access to markets have a wider variety of food items to choose from. These results warrant further analysis

of the relationship between market participation, agricultural production and food group consumption. We recognize the potential endogeneity in our models, as market participation affects both production and consumption. Further research should use an instrumental variable approach to analyzing the effect of market participation on production and consumption diversity. However, at this time, we do not have a strong instrument to use in the analysis.

In addition to the role of market participation on production and consumption decisions, the results show consumption and production patterns largely vary by district in Bangladesh. Farm and dietary diversity are higher among households in northern Bangladesh (Mymensingh), where growing conditions are more favorable in terms of climate, soil fertility, soil salinity, and perhaps access to agricultural extension services through the Bangladesh Agricultural University Extension Center (BAUEC). Further research on this topic should explore the extent to which geographical location impacts nutrition due to market access and price differentials in agricultural markets.

Because our sample is not nationally representative, the variation in consumption and production patterns may also reflect the different project activities offered by our partner agencies in the respective districts. The partner organizations were selected due to their existing collaboration with our funding agency, under the criteria that their beneficiaries had not received previous nutrition training. Thus, our results have some degree of bias from the sampling strategy. In particular, Shushilan, the partner agency in Borguna, focuses on climate resilient innovations for the extreme poor and landless. These households likely experience greater restrictions on market access due to financial constraints. Furthermore, Shushilan beneficiary households are predominately female-headed. In Bangladesh, traditional gender norms limit

women's access to markets. Future research should incorporate a measure of women's empowerment in addition to the gender of the head of household.

Table 4-1. FAO food groups and examples

Food Group	Examples (this list is not comprehensive)
Cereals	Rice, bread, wheat, biscuits, puffed rice
White roots and tubers	White potatoes, turnips
Vitamin A rich vegetables and tubers	Pumpkin, carrots, squash, orange-flesh sweet potato
Dark leafy green vegetables	Amaranth, spinach, taro leaf, pumpkin leaf, jute leaf
Other vegetables	Cucumber, radish, tomato, pepper, beans
Vitamin A rich fruits	Ripe papaya, ripe mango, orange, grapefruit
Other fruits	Banana, apple, jackfruit, watermelon, lychee
Meat	Chicken, beef, poultry, lamb, liver, kidney
Eggs	Eggs
Fish and seafood	Carp, hilsha fish, shrimp, prawn
Legumes, nuts, and seeds	Lentils, dal, black gram, kheshari, mung bean
Milk and milk products	Cow milk, goat milk, powdered milk, yogurt, curd, cheese
Oils and fats	Butter, ghee, mustard oil, soybean oil
Sweets	Sugar, honey, molasses, chocolate, ice cream, soda
Spices, condiments, beverages	Black pepper, salt, fish powder, chili sauce, cumin, coffee, tea

Table 4-2. Descriptive statistics covariates, by district

	All		Borguna		Mymensingh	
Variable	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Mymensingh	0.52	0.50	0.00	0.00	1.00	0.00
Muslim	0.95	0.21	0.92	0.28	0.99	0.11
Household food insecurity access score	1.96	3.70	3.54	4.39	0.52	2.07
Male-headed	0.85	0.36	0.75	0.43	0.94	0.23
Primary school	0.33	0.47	0.44	0.50	0.24	0.42
Junior secondary school	0.11	0.31	0.06	0.24	0.15	0.36
Secondary school	0.06	0.24	0.02	0.13	0.10	0.30
SSC pass	0.05	0.23	0.01	0.09	0.10	0.30
Post secondary education	0.07	0.25	0.00	0.06	0.12	0.33
Age of household head	45.14	12.69	44.53	12.48	45.69	12.86
Household size	4.62	1.68	4.13	1.44	5.07	1.76
Poverty	48.31	16.06	38.13	10.99	57.56	14.25
Total ag land (decimals)	72.88	104.06	49.39	97.96	94.23	104.92
Diversity of crops and livestock (count)	3.36	2.22	2.15	1.82	4.46	1.97
Buy food at market	0.40	0.49	0.61	0.49	0.21	0.40
Sell food at market	0.47	0.50	0.30	0.46	0.63	0.48

Table 4-3. Mean household consumption and production of food groups

	All		Borguna		Mymensingh	
Dependent Variable	Consumption	Production	Consumption	Production	Consumption	Production
Cereals	1.00	0.63	1.00	0.46	1.00	0.78
Vitamin A rich vegetables	0.18	0.09	0.17	0.01	0.20	0.17
White roots/tubers	0.77	0.07	0.66	0.07	0.86	0.07
Leafy green vegetables	0.53	0.17	0.49	0.05	0.56	0.27
Other vegetables	0.52	0.35	0.20	0.15	0.82	0.52
Vitamin A rich fruit	0.06	0.42	0.03	0.11	0.09	0.70
Other fruit	0.26	0.56	0.15	0.22	0.36	0.86
Meat	0.33	0.31	0.21	0.19	0.45	0.42
Eggs	0.24	0.58	0.18	0.47	0.28	0.67
Fish	0.75	0.27	0.58	0.12	0.90	0.41
Pulses	0.52	0.19	0.34	0.37	0.69	0.03
Dairy	0.22	0.29	0.08	0.26	0.34	0.31
Fats and oils	0.91	0.07	0.84	0.12	0.97	0.03
Sugar	0.24	--	0.07	--	0.39	--
Spices	0.77	--	0.72	--	0.81	--
Household Dietary Diversity Score	7.29	--	5.72	--	8.72	--
(HDDS)	<2.47>	--	<1.86>	--	<2.05>	--
Farm Diversity	--	3.36	--	2.15	--	4.46
(count of food groups produced)	--	<2.22>	--	<1.82>	--	<1.97>

Table 4-4. Marginal effects from Poisson regression on farm diversity score

VARIABLES	(1) All	(2) Borguna	(3) Mymensingh
District (Mymensingh = 1)	1.570***	--	--
	[0.290]	--	--
Religion (Muslim = 1)	-0.461	-0.506***	0.684**
	[0.298]	[0.142]	[0.331]
Household Food Insecurity Access Score	-0.102***	-0.044	-0.204***
	[0.030]	[0.030]	[0.033]
Male-headed household	-0.217	-0.156	-0.137
	[0.155]	[0.121]	[0.324]
Household head primary education	0.045	-0.071	0.094
	[0.172]	[0.213]	[0.205]
Household head junior secondary education	0.243	0.096	0.381*
	[0.194]	[0.414]	[0.195]
Household head secondary education	0.112	0.337	0.176
	[0.183]	[0.550]	[0.251]
Household head SSC pass	0.422*	-1.128***	0.753***
	[0.220]	[0.209]	[0.278]
Post secondary education	0.190	1.256***	0.263
	[0.277]	[0.464]	[0.371]
Age of household head	0.008*	0.002	0.014**
	[0.004]	[0.006]	[0.006]
Household size	0.084**	0.102	0.099**
	[0.033]	[0.064]	[0.041]
Poverty score	0.003	0.007	0.001
	[0.004]	[0.009]	[0.005]
Total cultivable land (decimals)	0.004***	0.003***	0.004***
	[0.001]	[0.001]	[0.001]
Buy food at market	0.184	-0.0881	0.349
	[0.158]	[0.236]	[0.227]
Sell food at market	1.101***	1.025***	1.160***
	[0.128]	[0.127]	[0.203]
Observations	1,130	535	595
Log Likelihood	-2150	-947.6	-1186

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 4-5. Marginal effects from Poisson regression on household dietary diversity score

VARIABLES	(1) All	(2) Borguna	(3) Mymensingh
District (Mymensingh = 1)	2.383***		
	[0.169]		
Religion (Muslim = 1)	0.340	0.207	0.444
	[0.218]	[0.241]	[0.328]
Household Food Insecurity Access Score	-0.093***	-0.082***	-0.085
	[0.023]	[0.015]	[0.084]
Male-headed household	0.034	0.287	-0.537**
	[0.229]	[0.201]	[0.256]
Household head primary education	-0.085	-0.355***	0.379*
	[0.146]	[0.130]	[0.213]
Household head junior secondary education	0.200	-0.039	0.475
	[0.211]	[0.371]	[0.323]
Household head secondary education	-0.060	-0.462	0.133
	[0.201]	[0.630]	[0.261]
Household head SSC pass	-0.015	0.910*	0.170
	[0.240]	[0.476]	[0.327]
Post secondary education	0.254*	-0.631**	0.529***
	[0.149]	[0.286]	[0.203]
Age of household head	1.74E-04	0.002	-0.001
	[0.004]	[0.005]	[0.006]
Household size	-0.017	-0.076	0.003
	[0.039]	[0.067]	[0.053]
Poverty score	3.00E-03	-0.012***	0.008
	[0.005]	[0.005]	[0.008]
Total cultivable land (decimals)	0.001	-0.002*	0.003***
	[0.001]	[0.001]	[0.001]
Farm diversity (count of food groups produced)	0.278***	0.357***	0.228***
	[0.043]	[0.051]	[0.049]
Buy food at market	0.218	0.071	0.434
	[0.140]	[0.158]	[0.277]
Sell food at market	-0.474**	-0.399*	-0.402
	[0.217]	[0.219]	[0.378]
Respondent prepares food for the household	0.311**	-0.328	0.470***
	[0.137]	[0.217]	[0.172]
Observations	1,130	535	595
Log Likelihood	-2408	-1084	-1313

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

CHAPTER 5
CONCLUDING REMARKS

Contributions

While much of the existing literature focuses on supply-side interventions for improving food security, this dissertation explored potential mechanisms for increasing the demand for a diverse diet. In a randomized controlled trial, we analyzed the effectiveness of a behavioral economics nudge and a behavior change communication intervention designed to promote nutrition and dietary diversity among agricultural households in Bangladesh. Our research also investigated the interdependence of nutrient-rich food consumption and traditional constraints such as accessibility and affordability.

We were particularly interested in the potential for a FBDG icon to serve as a nutrition nudge. In addition, we evaluated the effectiveness of nutrition education as a BCC tool. Thus, our methods explored the effectiveness of a behavioral economics nudge alone, behavior change communication alone, and the combination of the two. While BCC is often used to promote health and nutrition in developing countries, to our knowledge, no other study to date has produced empirical evidence on nudging nutrition decisions in a development context. We evaluated these behavior change interventions in the short-term, in a lab setting where food choices were observed, as well as in the home environment using pre-intervention and post-intervention survey data to capture the long-term effects. The lab setting removed constraints that influence individuals' food choices, such as income and access to nutrient-rich foods. Measuring the outcomes in the home environment allowed us to make a more comprehensive evaluation of the interventions. First, we observed whether the efficacy of either messaging mechanism changed in the home environment, where income and access constraints were restored. Secondly, we measured the long-term impact of repeated exposure to the nutrition nudge in the home

environment. Even in the United States, where a growing body of literature investigates the use of behavioral economics in nutrition, few studies measure the effectiveness of food-based dietary guidelines at nudging nutrition decisions in the home. Thus, our research informs literature on behavioral economics in nutrition for developed countries in addition to introducing novel methods for studying nutrition in the development context.

The results suggest our behavior change interventions produced weaker impacts in the home environment. Thus, this dissertation also investigated the role of income and access constraints on household nutrition decisions. We made a theoretical contribution to the economic framework linking agriculture and nutrition in developing countries. Specifically, we incorporated nutrition, market transaction costs, and the propensity to participate in markets into the agricultural household model. We then empirically analyzed how market participation affects the variety of food groups produced and consumed by households in Bangladesh.

Findings

The experimental results indicate that short-term exposure to a FBDG icon such as the BPP is not an effective nudge by itself. However, nutrition education in a participatory workshop is effective in the short-run, and combining the icon with nutrition education increases meal diversity. The analysis of meal observation data found that nutrition education increased mean meal diversity by 2.1%. The consumption of lentils and leafy green vegetables was higher among participants who received only nutrition education compared to the control. Similarly, nutrition and gender education led to a 0.017 increase on mean meal diversity compared to the control. There is no statistically significant evidence that the BPP alone nudged participants to choose a greater variety of food. However, the BPP combined with nutrition education increased mean meal diversity by 2.6%. The BPP encouraged the consumption of lentils when the nudge was

combined with nutrition education, but we found no evidence that either nutrition intervention reduced rice consumption.

The long-term analysis presented in Chapter 3 found mixed effects of the BPP and BCC interventions at home. Neither participatory training nor the nutrition nudge produced a change in 24-hour individual dietary diversity. However, the mean food consumption score (a 7-day measure) increased by 3.5 points and 3.7 points among participants who were assigned to the BPP treatment and the BPP combined with nutrition education, respectively. Furthermore, nutrition education with the gender component increased the food consumption score in the home. We suspect participants were better able to comply with the BPP and BCC messages over a 7-day period due to variation in consumption bundles based on the availability and accessibility of food in the market. In summary, we found weak evidence that long-term exposure to the BPP in the home environment increased dietary diversity.

Given the discrepancy in treatment outcomes between the lab and home environments, and the dietary diversity measures, Chapter 4 explored the role of income and access constraints on household dietary diversity. A conceptual framework first extended the agricultural household model to include nutrition, demonstrating how market transaction costs affect both production and consumption decisions. Empirically, we then analyzed the correlation between market participation and decisions surrounding the production and consumption of nutrients. The results suggest that participation in sellers' markets is positively correlated with farm diversity as households that engage in sellers' markets produce on average 1.1 additional food groups of 15 total possible food groups compared to subsistence households. Essentially, these findings suggest that market-orientation of the farm does not encourage specialization, but leads the farmer to produce a greater variety of food items. Our analysis revealed a negative relationship

between participation in sellers' markets and household dietary diversity. Households that sell agricultural products at the market consume 0.5 fewer food groups on average compared to subsistence households. As access to markets increase, there may be incentive for the household to sell more nutritious, high-value food items in order to purchase more staple crops such as rice from the market. An obvious limitation of this analysis is the endogeneity of market participation, farm diversity, and dietary diversity. At this time, we do not have a strong instrument to correct for endogeneity. An analysis on price differentials would also strengthen this contribution; however, these data are difficult to obtain due to the abundance of price negotiation that occurs in the market.

Policy Implications

If, indeed, agricultural households are selling nutritious food items and buying less nutritious food items for home consumption, then nutrition education has the potential to play a vital role in improving nutrition outcomes. Chapters 2 and 3 sought to inform agricultural extension agents and community health workers on the best practices for nutrition promotion. The results suggest a combined approach of behavior change communication with behavioral economics is most effective. Furthermore, long-term exposure to a nutrition nudge in the home environment could create sustainable impacts, depending on the frequency of exposure and access to diverse food items.

Among the participants who received the BPP, 11% reported never using the BPP at home. In many cases, individuals claimed to prefer the use of other plates. Additional consideration should be given to the design and practicality of nudges for the home environment, particularly in a developing country. Awareness of constraints such as literacy or gender norms surrounding decision-making and access to markets is critical in the design and implementation of tools for behavior change.

Precaution should be taken in the design of FBDG icons such as the BPP–the complexity of the tool may impede the beneficiary's ability to grasp messages in the short-term. In the short-term, our analysis found increases in the consumption of lentils and leafy green vegetables drove the increase in meal diversity–this may have been due to the prominence of these food items on the BPP. Furthermore, our short-term results showed that exposure to the BPP alone is not effective, but the combined interventions increased meal diversity. Combining methods of BCC with behavioral economics strategies is particularly important for uneducated beneficiaries who may be more reliant on verbal communication. Further research should investigate the extent to which these results translate to exposure to other messaging mechanisms such as posters or billboards.

While our findings inform practices for nutrition messaging, the main implication of the theoretical model in Chapter 4 is that nutrition-sensitive agriculture initiatives must consider market accessibility. Promoting agricultural technology or nutrition awareness alone is not sufficient to improve dietary diversity. Initiatives should take a comprehensive approach to nutrition-sensitive agriculture, considering market accessibility as well as information and tools for behavior change.

Future Research

Chapters 2 and 3 of this dissertation establish novel protocol for investigating the use of nudging to combat malnutrition in developing countries. The research methods can be extended to other developing countries to measure the effectiveness of local FBDG icons and other nutrition nudges as well as BCC strategies. Further research should evaluate alternative mechanisms for changing behavior to improve nutrition among rural households in low-income countries. The results from this dissertation suggest that traditional constraints such as income

and access to food markets may dampen the impact of nutrition interventions. Thus, incentive-based programs such as conditional cash transfers with nutrition nudges should be explored.

Our theoretical contribution in Chapter 4 defined the role of nutrition in the utility maximization of agricultural households. However, in practice, households may not be aware of the importance of a diverse diet and hence may not consider nutrient values of the food items they consume when maximizing utility. The reliance on culturally significant foods, such as rice in Bangladesh, is difficult to overcome. Thus, further studies should evaluate the impact of interventions that focus on the negative health impacts of consuming too much rice. Alternatively, interventions may emphasize the long-term health benefits of consuming a greater variety of nutritious food items and the extent to which those benefits justify the additional cost of healthy food items.

APPENDIX A
SUPPLEMENTARY TABLES

Table A-1. Covariate summary statistics by behavior change communication intervention (nutrition education)

	No education		Nutrition education		Nutrition and gender education	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mymensingh district	0.52	0.50	0.53	0.50	0.53	0.50
Borguna district	0.48	0.50	0.47	0.50	0.47	0.50
Household (HH) monthly income (BDT)	10584.76	8717.20	11398.47	10921.08	10601.08	8123.49
Poverty score	48.42	16.29	47.90	15.63	48.67	16.04
Number of food groups produced	3.37	2.30	3.41	2.16	3.37	2.22
Household food insecurity access score (HFIAS)	1.91	3.63	1.97	3.73	2.03	3.81
Religion (Muslim = 1)	0.96	0.20	0.96	0.20	0.95	0.22
Male	0.28	0.45	0.30	0.46	0.28	0.45
Female	0.72	0.45	0.70	0.46	0.72	0.45
Age	38.43	12.80	38.35	12.85	37.17	11.58
Highest level of education						
None	0.35	0.48	0.38	0.49	0.35	0.48
Primary school	0.35	0.48	0.31	0.46	0.34	0.47
Junior secondary school	0.12	0.32	0.11	0.31	0.10	0.30
Secondary school	0.05	0.23	0.06	0.23	0.07	0.26
SSC pass	0.04	0.20	0.06	0.24	0.06	0.25
Postsecondary education	0.08	0.26	0.07	0.25	0.06	0.23
Spouse of household head	0.50	0.50	0.51	0.50	0.54	0.50
Other relationship to household head	0.13	0.33	0.14	0.35	0.10	0.30
Hunger at time of meal event	3.71	1.14	3.69	1.20	3.68	1.18
Baseline nutrition knowledge score	18.59	5.29	18.78	5.41	18.98	4.76

Table A-2. Covariate summary statistics by behavioral economics intervention (Bengali Portion Plate)

	A (Regular, Regular)		B (Regular, BPP)		C (BPP, Regular)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Mymensingh district	0.56	0.50	0.52	0.50	0.51	0.50
Borguna district	0.44	0.50	0.48	0.50	0.49	0.50
Household (HH) monthly income (BDT)	11031.70	10131.77	10366.63	8564.72	11336.14	9520.77
Poverty score	49.03	16.81	47.88	15.48	48.13	15.69
Number of food groups produced	3.26	2.16	3.49	2.31	3.38	2.18
Household food insecurity access score (HFIAS)	1.79	3.41	2.17	4.00	1.92	3.67
Religion (Muslim = 1)	0.94	0.24	0.95	0.21	0.97	0.17
Male	0.18	0.38	0.42	0.49	0.25	0.43
Female	0.82	0.38	0.58	0.49	0.75	0.43
Age	36.84	12.02	39.11	12.61	37.76	12.52
Highest level of education						
None	0.31	0.46	0.38	0.49	0.39	0.49
Primary school	0.35	0.48	0.32	0.47	0.33	0.47
Junior secondary school	0.14	0.35	0.11	0.31	0.08	0.28
Secondary school	0.05	0.22	0.06	0.24	0.07	0.25
SSC pass	0.06	0.23	0.05	0.23	0.06	0.23
Postsecondary education	0.08	0.27	0.06	0.24	0.05	0.23
Spouse of household head	0.62	0.49	0.40	0.49	0.55	0.50
Other relationship to household head	0.13	0.34	0.09	0.29	0.15	0.36
Hunger at time of meal event	3.70	1.20	3.72	1.14	3.65	1.19
Baseline nutrition knowledge score	18.89	5.19	18.64	5.23	18.86	5.06

Table A-3. Summary statistics by treatment groups defined in Table 2-1

	Group 1		Group 2		Group 3		Group 4		Group 5		Group 6		Group 7		Group 8		Group 9	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St Dev.	Mean	St .Dev.	Mean	St .Dev.	Mean	St Dev.
Mymensingh district	0.58	0.49	0.59	0.49	0.52	0.50	0.51	0.50	0.51	0.50	0.54	0.50	0.48	0.50	0.51	0.50	0.52	0.50
Borguna district	0.42	0.49	0.41	0.49	0.48	0.50	0.49	0.50	0.49	0.50	0.46	0.50	0.52	0.50	0.49	0.50	0.48	0.50
Household (HH) monthly income (100 BDT)	103.39	72.37	122.65	127.96	104.66	93.93	97.56	83.06	110.48	98.92	102.63	71.59	119.99	104.69	110.09	101.54	111.30	77.84
Poverty score	49.42	17.40	49.49	16.68	48.22	16.41	47.00	15.78	47.18	14.98	49.54	15.63	49.26	15.62	47.28	15.32	48.11	16.16
Number of food groups produced	3.30	2.20	3.14	2.10	3.33	2.19	3.34	2.33	3.63	2.24	3.50	2.36	3.49	2.38	3.39	2.09	3.26	2.10
Household food insecurity access score (HFIAS)	1.67	3.24	1.68	3.19	2.00	3.77	2.27	4.20	2.42	4.12	1.81	3.65	1.70	3.14	1.74	3.70	2.31	4.03
Religion (Muslim = 1)	0.96	0.21	0.92	0.27	0.94	0.24	0.94	0.23	0.97	0.18	0.96	0.21	0.98	0.14	0.98	0.15	0.95	0.21
Male	0.13	0.33	0.20	0.40	0.20	0.40	0.44	0.50	0.43	0.50	0.39	0.49	0.24	0.43	0.26	0.44	0.24	0.43
Female	0.87	0.33	0.80	0.40	0.80	0.40	0.56	0.50	0.57	0.50	0.61	0.49	0.76	0.43	0.74	0.44	0.76	0.43
Age	38.51	13.50	34.68	10.81	37.39	11.39	38.67	12.14	40.86	13.54	37.69	11.86	38.00	12.95	38.85	13.04	36.34	11.44
Highest level of education																		
None	0.30	0.46	0.33	0.47	0.28	0.45	0.40	0.49	0.38	0.49	0.37	0.48	0.32	0.47	0.43	0.50	0.41	0.49
Primary school	0.37	0.48	0.30	0.46	0.39	0.49	0.29	0.45	0.34	0.48	0.32	0.47	0.40	0.49	0.28	0.45	0.32	0.47
Junior secondary school	0.13	0.33	0.13	0.34	0.16	0.37	0.12	0.32	0.12	0.32	0.08	0.27	0.10	0.31	0.08	0.28	0.07	0.25
Secondary school	0.05	0.23	0.05	0.22	0.04	0.20	0.05	0.21	0.06	0.23	0.09	0.29	0.06	0.25	0.06	0.24	0.08	0.27
SSC pass	0.04	0.21	0.06	0.24	0.07	0.25	0.03	0.18	0.06	0.24	0.07	0.25	0.05	0.22	0.06	0.24	0.06	0.24
Postsecondary education	0.09	0.28	0.11	0.31	0.05	0.22	0.09	0.29	0.03	0.16	0.07	0.25	0.04	0.20	0.07	0.25	0.05	0.22
Spouse of household head	0.63	0.48	0.60	0.49	0.63	0.48	0.39	0.49	0.38	0.49	0.43	0.50	0.51	0.50	0.55	0.50	0.59	0.49
Other relationship to household head	0.13	0.33	0.15	0.36	0.12	0.32	0.11	0.31	0.10	0.30	0.07	0.26	0.16	0.37	0.18	0.38	0.12	0.32
Hunger at time of meal event	3.80	1.10	3.63	1.25	3.67	1.23	3.67	1.14	3.74	1.15	3.74	1.14	3.65	1.18	3.68	1.20	3.61	1.19
Baseline nutrition knowledge score	18.83	5.13	19.06	5.64	18.79	4.78	18.20	5.35	18.48	5.62	19.26	4.60	18.88	5.37	18.86	4.96	18.83	4.92

Table A-4. Summary statistics by treatment groups defined in Table 2-2

	Control		N		NG		BPP		BPP x N		BPP x NG			
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.	X^2	P-value
Mymensingh district	0.54	0.50	0.54	0.50	0.53	0.50	0.50	0.50	0.51	0.50	0.52	0.50	1.87	0.87
Borguna district	0.46	0.50	0.46	0.50	0.47	0.50	0.50	0.50	0.49	0.50	0.48	0.50	1.87	0.87
Household (HH) monthly income (BDT)	10549.91	8390.05	11577.47	11417.35	10579.59	8462.56	10651.71	9331.26	11072.66	9966.18	10641.96	7451.97	284.14	0.59
Poverty score	48.72	16.55	48.27	15.90	48.66	16.13	47.83	15.79	47.23	15.13	48.69	15.91	409.89	0.10
Number of food groups produced	3.35	2.28	3.34	2.15	3.36	2.22	3.40	2.35	3.52	2.17	3.38	2.25	40.43	0.83
Household food insecurity access score	1.87	3.57	1.93	3.65	2.03	3.81	1.99	3.75	2.05	3.89	2.04	3.82	118.60	0.02
Religion (Muslim = 1)	0.96	0.20	0.95	0.22	0.95	0.23	0.96	0.20	0.97	0.17	0.95	0.21	3.03	0.70
Male	0.24	0.43	0.28	0.45	0.26	0.44	0.36	0.48	0.35	0.48	0.32	0.47	19.60	0.00
Female	0.76	0.43	0.72	0.45	0.74	0.44	0.64	0.48	0.65	0.48	0.68	0.47	19.60	0.00
Age	38.50	12.97	37.58	12.50	37.23	11.54	38.29	12.49	39.76	13.37	37.04	11.68	288.23	0.11
Highest level of education														
None	0.34	0.47	0.37	0.48	0.34	0.47	0.37	0.48	0.40	0.49	0.39	0.49	4.98	0.42
Primary school	0.35	0.48	0.31	0.46	0.35	0.48	0.33	0.47	0.32	0.47	0.32	0.47	3.70	0.59
Junior secondary school	0.12	0.32	0.12	0.32	0.12	0.32	0.12	0.32	0.10	0.30	0.07	0.26	4.31	0.51
Secondary school	0.05	0.23	0.05	0.22	0.07	0.25	0.05	0.23	0.06	0.24	0.08	0.27	3.27	0.66
SSC pass	0.04	0.20	0.06	0.24	0.07	0.25	0.04	0.20	0.06	0.24	0.06	0.24	4.33	0.50
Postsecondary education	0.08	0.27	0.08	0.27	0.06	0.23	0.07	0.26	0.05	0.21	0.06	0.24	4.95	0.42
Spouse of household head	0.53	0.50	0.53	0.50	0.57	0.50	0.44	0.50	0.46	0.50	0.50	0.50	13.90	0.02
Other relationship to household head	0.13	0.33	0.14	0.35	0.11	0.31	0.13	0.34	0.14	0.35	0.09	0.29	5.80	0.33
Hunger at time of meal event	3.63	1.13	3.66	1.21	3.59	1.20	3.86	1.15	3.73	1.18	3.84	1.14	29.22	0.08
Baseline nutrition knowledge score	18.56	5.29	18.81	5.50	18.93	4.76	18.67	5.30	18.72	5.25	19.05	4.78	148.07	0.64

Table A-5. T-test on mean meal diversity score (MDS) by meal for BPP treatment groups

	Mean MDS				
Treatment (Meal 1, Meal 2)	Meal 1	Meal 2	Difference	T stat	P-value
Treatment A (Regular, Regular)	0.77	0.77	0.00	0.29	0.772
Treatment B (Regular, BPP)	0.78	0.78	0.00	0.06	0.955
Treatment C (BPP, Regular)	0.77	0.78	0.01	2.92	0.004

Table A-6. T-test for order effects: mean difference in MDS_{BPP} and $MDS_{Regular}$ by order of exposure to the BPP

	Treatment B (BPP in Meal 2)	Treatment C (BPP in Meal 1)	Difference (B vs. C)	T stat	P-value	P-value lower	P-value upper
Mean difference ($MDS_{BPP} - MDS_{Regular}$)	-0.0001	0.0144	-0.0145	-1.375	0.179	0.0896	0.9104
Std. Error	0.0073	0.0076	0.0106				
Clusters	17	16					
Intra-cluster correlation = 0.061							

Table A-7. Coefficient estimates from Poisson regression of treatments on individual dietary diversity score (IDDS)

VARIABLES	(1) IDDS	(2) IDDS
BPP only	-0.015	-0.006
	[0.073]	[0.032]
Nutrition education	-0.018	-0.004
	[0.044]	[0.039]
Nutrition education with gender	-0.009	0.029
	[0.030]	[0.026]
BPP x nutrition education	-0.005	-0.002
	[0.070]	[0.031]
BPP x nutrition education with gender	0.025	0.020
	[0.076]	[0.035]
Post	0.089	0.094*
	[0.056]	[0.054]
BPP x post	0.011	0.006
	[0.059]	[0.058]
Nutrition education x post	-0.022	-0.029
	[0.064]	[0.064]
Nutrition education with gender x post	-0.032	-0.037
	[0.061]	[0.060]
BPP x nutrition education x post	-0.020	-0.024
	[0.061]	[0.060]
BPP x nutrition education with gender x post	0.001	-0.006
	[0.063]	[0.061]
Mymensingh district		0.407***
		[0.018]
Gender (female = 1)		-0.018
		[0.026]
Age		0.001
		[0.001]
Primary school (highest level)		0.032**
		[0.016]
Junior secondary school (highest level)		0.056**
		[0.026]
Secondary school (highest level)		0.083***
		[0.027]
SSC pass (highest level)		0.068**
		[0.031]
Postsecondary education		0.066*
		[0.034]
Responsible for food preparation		0.037*
		[0.020]

Table A-7. Continued.

VARIABLES	(1) IDDS	(2) IDDS
Total cultivable land (decimals)		1.20E-04***
		[2.53E-05]
Farm diversity (count of food groups produced)		0.017***
		[0.005]
Constant	1.981***	1.608***
	[0.056]	[0.065]
Number of observations	2,164	2,164
Log Likelihood	-5153	-4704

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A-8. Results from logit regressions on food group production (odds ratios)

VARIABLES	Cereals	Vitamin A rich veg	White roots/tubers	Leafy green veg	Other vegetables	Vitamin A rich fruit	Fruit	Meat	Eggs	Fish	Pulses	Dairy	Oilseeds
Mymensingh	3.420***	0.496	29.558***	5.175***	3.979***	11.516***	14.223***	2.781***	1.706***	2.018**	0.006***	0.872	0.036***
	[1.241]	[0.228]	[22.289]	[2.005]	[1.059]	[2.836]	[3.451]	[0.633]	[0.303]	[0.683]	[0.006]	[0.198]	[0.021]
Muslim	0.206	0.350**	1.337	1.035	0.454*	0.757	0.722	0.973	1.714**	0.327***	0.79	1.084	1.129
	[0.221]	[0.156]	[0.586]	[0.549]	[0.188]	[0.515]	[0.275]	[0.527]	[0.365]	[0.108]	[0.397]	[0.182]	[0.668]
Household food insecurity access score (HFIAS)	0.946*	0.938**	0.974	0.913***	0.976	0.96	0.944**	0.986	0.963**	0.909***	0.910***	1.017	0.913
	[0.029]	[0.029]	[0.054]	[0.026]	[0.024]	[0.035]	[0.024]	[0.031]	[0.017]	[0.033]	[0.030]	[0.031]	[0.076]
Male-headed household	3.046	0.588	2.583	0.765	0.702**	0.886	0.824	0.722	0.753*	1.329	0.864	0.985	1.538
	[2.415]	[0.269]	[2.042]	[0.244]	[0.114]	[0.221]	[0.182]	[0.160]	[0.124]	[0.401]	[0.245]	[0.180]	[0.701]
Household head primary education	1.298	0.575**	0.615*	0.994	1.082	1.131	0.685**	1.392*	1.063	1.409*	0.849	0.983	0.679
	[0.638]	[0.151]	[0.171]	[0.259]	[0.270]	[0.217]	[0.130]	[0.267]	[0.155]	[0.277]	[0.205]	[0.175]	[0.274]
Household head junior secondary education	1.696	0.93	0.467	1.078	1.742**	1.973***	0.679	1.392*	1.003	2.069***	0.933	0.905	0.697
	[0.976]	[0.372]	[0.217]	[0.260]	[0.472]	[0.434]	[0.212]	[0.243]	[0.193]	[0.534]	[0.389]	[0.274]	[0.394]
Household head secondary education	0.576	0.875	0.303***	0.965	1.706	1.817	2.105**	0.964	0.782	1.618*	0.644	1.277	0.559
	[0.440]	[0.485]	[0.138]	[0.297]	[0.564]	[0.840]	[0.800]	[0.297]	[0.231]	[0.437]	[0.559]	[0.365]	[0.441]
Household head SSC pass	0.788	1.352	1.05	0.782	2.221**	2.441**	1.072	1.507	1.65	1.932*	0.773	1.024	0.384
	[0.668]	[0.632]	[0.526]	[0.248]	[0.728]	[0.866]	[0.520]	[0.506]	[0.551]	[0.662]	[0.698]	[0.298]	[0.393]
Household head postsecondary education	0.318*	1.09	0.715	0.993	0.985	1.874	2.641*	0.507*	0.991	2.576***	0.304	0.962	2.233
	[0.216]	[0.703]	[0.312]	[0.344]	[0.372]	[0.779]	[1.347]	[0.184]	[0.272]	[0.877]	[0.352]	[0.361]	[1.598]
Age of household head	0.993	0.998	1.014*	0.995	1.013**	1.000	1.007	1.006	0.995	1.014**	1.012***	1.009	0.998
	[0.009]	[0.009]	[0.008]	[0.007]	[0.007]	[0.008]	[0.007]	[0.006]	[0.006]	[0.006]	[0.005]	[0.006]	[0.009]
Household size	1.023	0.921	0.99	0.945	1.051	1.051	1.080*	1.051	1.133***	1.085*	1.081	1.113*	1.152
	[0.081]	[0.065]	[0.074]	[0.051]	[0.049]	[0.059]	[0.045]	[0.041]	[0.046]	[0.052]	[0.079]	[0.062]	[0.135]
Poverty score	0.986*	1.005	0.998	0.998	0.998	1.014*	1.004	0.999	0.998	1.017***	0.992	0.998	1.000
	[0.008]	[0.011]	[0.008]	[0.007]	[0.006]	[0.007]	[0.007]	[0.006]	[0.006]	[0.006]	[0.009]	[0.006]	[0.011]
Total cultivable land (decimals)	1.11	1.002**	1.005***	1.003***	1.006***	1.001**	1.002	1.001	1.000	1.000	1.012***	1.004***	1.005***
	[0.085]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.004]	[0.001]	[0.001]
Buy food at market	1.101	0.67	0.817	1.237	1.019	1.325	1.267	1.111	0.969	0.888	1.071	1.168	0.472***
	[0.406]	[0.200]	[0.290]	[0.358]	[0.187]	[0.293]	[0.327]	[0.194]	[0.143]	[0.168]	[0.263]	[0.211]	[0.131]
Sell food at market	3.732***	2.940***	1.626	1.558*	2.287***	1.167	1.773***	1.820***	1.493**	1.352*	3.163***	2.027***	3.950***
	[1.529]	[0.720]	[0.524]	[0.409]	[0.421]	[0.160]	[0.302]	[0.303]	[0.239]	[0.219]	[0.689]	[0.290]	[0.988]
Constant	0.133	0.391	0.001***	0.098***	0.120***	0.063***	0.176**	0.126***	0.505*	0.057***	0.254*	0.080***	0.050***
	[0.308]	[0.325]	[0.001]	[0.069]	[0.065]	[0.053]	[0.128]	[0.083]	[0.189]	[0.029]	[0.190]	[0.033]	[0.057]
Observations	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130
Pseudo R-squared	0.675	0.0713	0.251	0.126	0.216	0.314	0.365	0.0792	0.0553	0.152	0.403	0.0739	0.223
Log Likelihood	-241.6	-270.7	-261.9	-445.9	-575	-528.1	-491.8	-641.7	-727.5	-561.2	-327.7	-627.9	-228.5

Robust se eform in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A-9. Results from logit regressions on food group consumption (odds ratios)

VARIABLES	Cereals	Vitamin A rich vegetables	White roots/tubers	Leafy green vegetables	Other vegetables	Vitamin A rich fruit	Fruit	Meat	Eggs	Fish	Pulses	Dairy	Oilseeds	Sugar	Spices
Mymensingh	0.206*	1.089	2.913***	1.145	24.247***	2.997**	1.987	1.622**	1.209	4.844***	2.808***	4.333***	3.711***	9.544***	1.321
	[0.194]	[0.320]	[0.677]	[0.314]	[7.558]	[1.584]	[0.946]	[0.398]	[0.251]	[1.653]	[0.504]	[0.946]	[1.360]	[3.410]	[0.655]
Muslim	284.550***	0.297***	0.856	0.941	1.066	1.124	1.39	6.071***	0.863	2.083***	1.306	1.433	0.773	2.703**	0.845
	[448.744]	[0.082]	[0.327]	[0.375]	[0.213]	[0.970]	[0.923]	[3.934]	[0.284]	[0.404]	[0.229]	[0.383]	[0.511]	[1.320]	[0.479]
Household food insecurity access score (HFIAS)	0.897	1.022	1.005	0.961***	0.937***	1.138***	0.993	0.929**	0.938***	0.915***	0.964**	0.992	0.947	0.998	0.943*
	[0.078]	[0.026]	[0.021]	[0.014]	[0.018]	[0.041]	[0.032]	[0.027]	[0.022]	[0.012]	[0.014]	[0.028]	[0.037]	[0.032]	[0.029]
Male-headed household	1.554	1.448	1.05	0.849*	1.294	0.909	0.685**	0.9	1.048	1.12	0.835	0.683	1.088	0.976	1.383
	[0.675]	[0.430]	[0.242]	[0.084]	[0.432]	[0.355]	[0.128]	[0.220]	[0.217]	[0.239]	[0.180]	[0.213]	[0.277]	[0.255]	[0.275]
Household head primary education	10.103***	0.756	0.681***	0.902	0.751	1.951**	1.032	1.142	1.011	0.85	1.009	1.745***	0.849	1.102	1.162
	[5.817]	[0.157]	[0.099]	[0.146]	[0.157]	[0.563]	[0.250]	[0.201]	[0.160]	[0.149]	[0.155]	[0.367]	[0.219]	[0.216]	[0.227]
Household head junior secondary education	–	1.034	1.132	0.866	0.941	2.483*	1.194	1.568**	0.785	0.636	1.033	1.666**	0.709	1.574	1.419
	–	[0.294]	[0.333]	[0.170]	[0.271]	[1.349]	[0.313]	[0.343]	[0.243]	[0.191]	[0.257]	[0.393]	[0.308]	[0.478]	[0.389]
Household head secondary education	–	0.687	0.824	0.84	0.896	0.966	1.038	1.28	0.894	1.171	1.241	1.840**	1.398	0.781	0.838
	–	[0.308]	[0.285]	[0.247]	[0.294]	[0.566]	[0.320]	[0.428]	[0.319]	[0.475]	[0.339]	[0.549]	[0.897]	[0.227]	[0.236]
Household head SSC pass	–	0.501	0.783	1.253	1.908	0.451	0.928	1.198	0.922	0.779	1.103	1.165	0.454	1.275	1.536
	–	[0.215]	[0.260]	[0.345]	[0.775]	[0.301]	[0.260]	[0.352]	[0.386]	[0.340]	[0.359]	[0.418]	[0.284]	[0.341]	[0.581]
Household head postsecondary education	–	0.708	0.861	1.066	1.108	2.738*	1.322	1.685	1.615*	0.595	1.302	1.271	2.107	1.444	1.106
	–	[0.224]	[0.341]	[0.324]	[0.370]	[1.536]	[0.339]	[0.542]	[0.430]	[0.315]	[0.402]	[0.319]	[2.203]	[0.346]	[0.358]
Age of household head	1.070	0.997	0.998	0.996	1.008	0.998	1.010	0.997	1.001	0.989*	0.995	1.007	1.004	1.009	0.999
	[0.044]	[0.006]	[0.006]	[0.006]	[0.005]	[0.011]	[0.007]	[0.008]	[0.006]	[0.007]	[0.005]	[0.006]	[0.007]	[0.006]	[0.008]
Household size	1.332	0.985	0.97	0.995	0.916*	0.961	1.000	1.014	0.988	0.931	1.039	0.975	1.143*	0.943	0.977
	[0.481]	[0.055]	[0.041]	[0.045]	[0.048]	[0.093]	[0.050]	[0.053]	[0.047]	[0.055]	[0.052]	[0.056]	[0.084]	[0.039]	[0.053]
Poverty score	0.93	1.009	0.993	0.991	0.991	1.016	1.004	1.012*	1.014**	0.998	1.000	0.998	0.999	0.996	1.001
	[0.058]	[0.006]	[0.008]	[0.006]	[0.008]	[0.011]	[0.007]	[0.006]	[0.007]	[0.006]	[0.005]	[0.006]	[0.009]	[0.008]	[0.008]
Total cultivable land (decimals)	1.001	1.000	1.000	1.000	0.999	1.001	1.000	1.001	1.001	0.999	0.999	1.002***	0.999	1.002**	0.999
	[0.003]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.001]
Farm diversity (count of food groups produced)	1.063	1.043	1.087*	1.106***	1.338***	1.137	1.269***	1.032	1.022	1.082*	1.089**	1.271***	1.204**	1.128**	1.239***
	[0.285]	[0.049]	[0.047]	[0.032]	[0.065]	[0.091]	[0.071]	[0.045]	[0.054]	[0.045]	[0.043]	[0.057]	[0.099]	[0.055]	[0.052]
Buy food at market	3.053**	0.914	0.904	0.902	2.859***	1.125	0.99	1.17	1.344*	0.823	0.881	1.571**	0.813	1.846***	1.364
	[1.473]	[0.184]	[0.183]	[0.130]	[0.695]	[0.389]	[0.194]	[0.232]	[0.234]	[0.198]	[0.138]	[0.279]	[0.235]	[0.351]	[0.358]
Sell food at market	1.41	0.991	1.042	0.766*	0.505***	0.887	0.666**	1.065	1.045	0.798	1.103	1.116	0.593	0.627*	0.393***
	[2.639]	[0.265]	[0.172]	[0.122]	[0.124]	[0.449]	[0.130]	[0.167]	[0.206]	[0.121]	[0.137]	[0.215]	[0.191]	[0.159]	[0.063]
Constant	1.06	0.386*	3.552*	2.294	0.119***	0.005***	0.060***	0.032***	0.127***	2.564***	0.504*	0.018***	4.311	0.015***	2.392
	[0.909]	[0.198]	[2.554]	[1.191]	[0.075]	[0.006]	[0.051]	[0.026]	[0.043]	[0.865]	[0.186]	[0.011]	[4.609]	[0.011]	[1.802]
Number of observations	797	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130
Pseudo R-squared	0.328	0.0218	0.0642	0.0167	0.361	0.0934	0.0927	0.0898	0.0382	0.152	0.0981	0.161	0.124	0.178	0.0638
Log Likelihood	-13.26	-522	-574.9	-768.4	-499.7	-242.9	-585.8	-657.3	-588.5	-539.9	-705.3	-494.4	-298	-517.1	-572.9

Robust se eform in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A-10. Coefficient estimates from Poisson regression on farm diversity score

VARIABLES	All	Borguna	Mymensingh
District (Mymensingh = 1)	0.465***		
	[0.094]		
Religion (Muslim = 1)	-0.137	-0.234***	0.153**
	[0.090]	[0.080]	[0.072]
Household Food Insecurity Access Score	-0.030***	-0.020	-0.046***
	[0.008]	[0.013]	[0.007]
Male-headed household	-0.064	-0.072	-0.031
	[0.046]	[0.056]	[0.073]
Household head primary education	0.013	-0.033	0.021
	[0.051]	[0.099]	[0.046]
Household head junior secondary education	0.072	0.044	0.085**
	[0.058]	[0.192]	[0.043]
Household head secondary education	0.033	0.156	0.039
	[0.054]	[0.250]	[0.056]
Household head SSC pass	0.125*	-0.523***	0.168***
	[0.064]	[0.076]	[0.060]
Post secondary education	0.056	0.582**	0.059
	[0.082]	[0.234]	[0.082]
Age of household head	0.002*	0.001	0.003**
	[0.001]	[0.003]	[0.001]
Household size	0.025**	0.047	0.022**
	[0.010]	[0.031]	[0.009]
Poverty score	0.001	0.003	1.57E-04
	[0.001]	[0.004]	[0.001]
Total cultivable land (decimals)	0.001***	0.001***	0.001***
	[1.52E-04]	[3.16E-04]	[1.35E-04]
Buy food at market	0.055	-0.041	0.078
	[0.047]	[0.109]	[0.051]
Sell food at market	0.326***	0.475***	0.260***
	[0.039]	[0.065]	[0.047]
Constant	0.561***	0.498	0.805***
	[0.142]	[0.341]	[0.108]
Observations	1,132	537	595
Log Likelihood	-2150	-947.6	-1186

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A-11. Coefficient estimates from Poisson regression on household dietary diversity score

VARIABLES	All	Borguna	Mymensingh
District (Mymensingh = 1)	0.326***		
	[0.023]		
Religion (Muslim = 1)	0.046	0.036	0.051
	[0.030]	[0.042]	[0.037]
Household Food Insecurity Access Score	-0.013***	-0.014***	-0.010
	[0.003]	[0.003]	[0.010]
Male-headed household	0.005	0.050	-0.062**
	[0.031]	[0.035]	[0.029]
Household head primary education	-0.012	-0.062***	0.043*
	[0.020]	[0.022]	[0.025]
Household head junior secondary education	0.027	-0.007	0.054
	[0.029]	[0.065]	[0.037]
Household head secondary education	-0.008	-0.081	0.015
	[0.027]	[0.110]	[0.030]
Household head SSC pass	-0.002	0.159*	0.019
	[0.033]	[0.083]	[0.038]
Post secondary education	0.035*	-0.110**	0.061**
	[0.020]	[0.050]	[0.024]
Age of household head	2.38E-05	3.95E-04	-8.34E-04
	[0.001]	[0.001]	[0.001]
Household size	-0.002	-0.013	3.52E-04
	[0.005]	[0.012]	[0.006]
Poverty score	3.98E-04	-0.002***	0.001
	[0.001]	[0.001]	[0.001]
Total cultivable land (decimals)	7.67E-05	-3.12E-04**	2.92E-04***
	[1.10E-04]	[1.66E-04]	[8.07E-05]
Farm diversity (count of food groups produced)	0.038***	0.062***	0.026***
	[0.006]	[0.009]	[0.006]
Buy food at market	0.030	0.012	0.050
	[0.019]	[0.027]	[0.032]
Sell food at market	-0.065**	-0.070*	-0.046
	[0.030]	[0.038]	[0.043]
Food preparer	0.043**	-0.057	0.054***
	[0.019]	[0.038]	[0.020]
Constant	1.614***	1.806***	1.944***
	[0.060]	[0.111]	[0.058]
Observations	1,130	535	595
Log Likelihood	-2408	-1084	-1313

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

APPENDIX B
BASELINE QUESTIONNAIRE

Q1 Hello, my name is _____ and I am conducting research on behalf of the Bangladesh Agricultural University and the University of Florida. We are conducting research about household food availability and access. This research is for a doctoral dissertation at the University of Florida in the United States of America. First of all, I would like to thank you for taking the time to meet with me. We would like to ask you some questions about yourself, your household, and your food consumption and diet. This interview should take approximately 30 minutes to 1 hour, and again I thank you for your time. Your participation in this study will be confidential to the extent provided by law, and your responses and comments will be anonymous. There are no direct benefits, risks, or compensation to you for participating in this study. Participation in this study is completely voluntary, and you may withdraw your consent to participate at any time without penalty. In addition to the interview, we invite you to attend a workshop and lunch we have scheduled for _____ (date on meal ticket). To participate in this research, you must attend the extension workshop. You will be given a meal as compensation for your time.

Q2 Are you available and willing to participate in the workshop?
- ❍ Yes (1)
- ❍ No (2)

Q3 Thank you for your participation. I will be asking questions about your household members and yourself, your household income, agricultural production, food availability and access. Your responses will be completely private and will only be connected with your name through an identification number. The list connecting your name with the identification number will be destroyed at the end of the study, so after that, your responses will be completely anonymous. We understand that you may not have all of the precise information available. It is important for the information in this study to be as accurate as possible. Please try to answer as many questions as you can, but if you cannot remember some information, it is ok to answer 'I do not remember'. Finally, you have the right to not answer any question we might ask. You may also choose to stop answering questions at any time. If you do, we will not collect any more information from you. However, we would keep and use the information we had already collected from you.

Q4 Given this information, are you willing to participate in this survey and the workshop?
- ❍ Yes (1)
- ❍ No (2)

Q5 Enumerator Name (Last name, First name)

- ❍ Afroza (2)
- ❍ Alamin (17)
- ❍ Ame (4)
- ❍ Anik (6)
- ❍ Anup (7)
- ❍ Ayesha (8)
- ❍ Azil (9)
- ❍ Diti (37)
- ❍ Eva (10)
- ❍ Himu (11)
- ❍ Jenny (12)
- ❍ Mahmud (14)
- ❍ Mumu (15)
- ❍ Nilima (39)
- ❍ Nosib (3)
- ❍ Pinkey (18)
- ❍ Prodip (19)
- ❍ Rabbi (20)
- ❍ Rubyeat (21)
- ❍ Sadia (Urvi) (24)
- ❍ Sajib (22)
- ❍ Shakir (25)
- ❍ Shaon (26)
- ❍ Shatabdi (36)
- ❍ Shirin (38)
- ❍ Shoaib (31)
- ❍ Shuvo (27)
- ❍ Tapoti (35)
- ❍ Tania (29)
- ❍ Wahidul (28)

Q6 District

- ❍ Mymensingh (1)
- ❍ Borguna (2)

Q7 Upazila

- ❍ Mymensingh Sadar (1)
- ❍ Amtoli (2)

Q8 Union

- ❍ Chowra (1)
- ❍ Holdia (2)

Answer If District Borguna Is Selected

Q9 Sushilan Village

- ❍ Baitakata (1)
- ❍ Baitmore (2)
- ❍ Chalavanga (3)
- ❍ Chandra (4)
- ❍ Chandra Kapali (5)
- ❍ Ghatkhali (6)
- ❍ Gilatali (7)
- ❍ Holdia (8)
- ❍ Holodia (Paka) (9)
- ❍ Holodia (10)
- ❍ Kalibari (11)
- ❍ Kawnia (12)
- ❍ Kawnia Kapali (13)
- ❍ Loda (14)
- ❍ Patakata (15)
- ❍ Patakata midle (16)
- ❍ Uttar Tokta Bunia (17)

Answer If District Mymensingh Is Selected

Q316 BAU Village

- ❍ Boira moddopara sorkar bari (1)
- ❍ Boira mosque (2)
- ❍ Borobilarpar (3)
- ❍ Bot tola bazar (4)
- ❍ Bot tola hatem bapari (5)
- ❍ Chor nilokkhai ujanpara (6)
- ❍ Chorkalibari shomvuganj (7)
- ❍ Chornillokhia digolpara (8)
- ❍ Goneshampur (9)
- ❍ Gosta north (10)
- ❍ Jhaugau (11)
- ❍ Jogir ali chor nilokkhia (12)
- ❍ Kismat khagdohor (13)
- ❍ Maijbari (14)
- ❍ Mirjapur east (15)
- ❍ Mirjapur north (16)
- ❍ Mirjapur south (17)
- ❍ Muktijodda bazar chor (18)
- ❍ Mukhtijoddha bazar jogir algi (19)
- ❍ Pagla Bazaar (20)
- ❍ Pagla bazar kazi bari (21)
- ❍ Pagla bazar mojiborer bari (22)
- ❍ Ragobpur (23)
- ❍ Sathiapara (24)
- ❍ Sathiapra chor nillokkhia (25)
- ❍ Shailmari purrush (26)
- ❍ Suhila moddopara (27)
- ❍ Suhila nodir par (28)
- ❍ Suhila north (29)
- ❍ Sutiakhali middle (30)
- ❍ Sutiakhali palpara 1 (31)
- ❍ Sutiakhali palpara 2 (32)
- ❍ Vabokhali pwest (33)
- ❍ Vabukhali (34)

Q317 BHH Code (Sushilan) or S.I. Number (BAUEC)

Q10 Thank you for participating in this study. I would like to start by asking some information about you.

Q11 Respondent Name

First name (1)

Last name (2)

Q12 Do you have a mobile number where we can reach you? If so, what is your number?

Q13 Gender

- ❍ Male (1)
- ❍ Female (2)

Q14 Are you the head of household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you the head of household? No Is Selected

Q15 What is your relationship to the head of household?

- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Daughter-in-law/Son-in-law (8)
- ❍ Brother/Sister (9)
- ❍ Father-in-law/Mother-in-law (10)
- ❍ Nephew/Niece (11)
- ❍ Grandfather/Grandmother (12)
- ❍ Grandson/Granddaughter (13)
- ❍ Sister-in-law/Brother-in-law (14)
- ❍ Brother's wife (15)
- ❍ Other (e.g. servant) (16)

Q16 What is your marital status?

- ❍ Married (1)
- ❍ Single (never married) (2)
- ❍ Widowed (3)
- ❍ Divorced (5)
- ❍ Separated (4)

Q17 What is your age?

Q18 What is the highest level of education you have completed?

- ❍ None (1)
- ❍ Class 1 (2)
- ❍ Class 2 (3)
- ❍ Class 3 (4)
- ❍ Class 4 (5)
- ❍ Class 5 (6)
- ❍ Class 6 (7)
- ❍ Class 7 (8)
- ❍ Class 8 (9)
- ❍ Class 9 (10)
- ❍ Class 10 (17)
- ❍ SSC Pass (11)
- ❍ HSC Pass (12)
- ❍ Graduate (13)
- ❍ Post-graduate (14)
- ❍ Medical (15)
- ❍ Vocational/Technical education (16)

Q19 What is your primary occupation?

- ❍ Farming (own land) (1)
- ❍ Poultry and livestock rearing (2)
- ❍ Sharecropper (3)
- ❍ Agricultural day labor/contract labor (4)
- ❍ Fishing (own boat) (5)
- ❍ Fishing labor (someone else's boat) (6)
- ❍ Fish farming (7)
- ❍ Boat operation (8)
- ❍ Rickshaw/van operator (9)
- ❍ Casual labor (10)
- ❍ Self-employed in business/petty business
- ❍ Non-agricultural day labor/contract labor (12)
- ❍ Regular salaried employment (13)
- ❍ Paid "volunteer" (14)
- ❍ Housework (child care/home care) (15)
- ❍ Servant/maid (16)
- ❍ Student (17)
- ❍ Beggar (18)
- ❍ Unemployed (19)
- ❍ Old/Disabled (20)
- ❍ Other (21) _____
- ❍ N/A (22)

Answer If Primary occupation Other Is Selected

Q20 Specify your primary occupation.

Q21 What is your secondary occupation?

- ❍ Farming (own land) (1)
- ❍ Poultry and livestock rearing (2)
- ❍ Sharecropper (3)
- ❍ Agricultural day labor/contract labor (4)
- ❍ Fishing (own boat) (5)
- ❍ Fishing labor (someone else's boat) (6)
- ❍ Fish farming (7)
- ❍ Boat operation (8)
- ❍ Rickshaw/van operator (9)
- ❍ Casual labor (10)
- ❍ Self-employed in business/petty business (11)
- ❍ Non-agricultural day labor/contract labor (12)
- ❍ Regular salaried employment (13)
- ❍ Paid "volunteer" (14)
- ❍ Housework (child care/home care) (15)
- ❍ Servant/maid (16)
- ❍ Student (17)
- ❍ Beggar (18)
- ❍ Unemployed (19)
- ❍ Old/Disabled (20)
- ❍ Other (21) _____
- ❍ N/A (22)

Answer If Secondary occupation Other Is Selected

Q22 Specify your secondary occupation.

Q23 Now I would like to ask some questions about your household members.How many individuals, NOT including yourself, live in your household? Please include the people who habitually eat and sleep in the home, including those who have been absent less than six months and have not established another residence. This includes maids or servants who live in the household.

- ❍ 0 (21)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)
- ❍ 11 (11)
- ❍ 12 (12)
- ❍ 13 (13)
- ❍ 14 (14)
- ❍ 15 (15)
- ❍ 16 (16)
- ❍ 17 (17)
- ❍ 18 (18)
- ❍ 19 (19)
- ❍ 20 (20)

Q24 Household member name
First name (1)

Q25 Gender
- ❍ Male (1)
- ❍ Female (2)

Q26 What is ${q://QID26/ChoiceTextEntryValue/1}'s age? If under 1 year, enter 0.

Q27 Marital status
- ❍ Married (1)
- ❍ Single (never married) (2)
- ❍ Widowed (3)
- ❍ Divorced (4)
- ❍ Separated (5)

Q28 Relationship to head of household

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Daughter-in-law/Son-in-law (8)
- ❍ Brother/Sister (9)
- ❍ _____
- ❍ Father-in-law/Mother-in-law (10)
- ❍ Nephew/Niece (11)
- ❍ Grandfather/Grandmother (12)
- ❍ Grandson/Granddaughter (13)
- ❍ Sister-in-law/Brother-in-law (14)
- ❍ Brother's wife (15)
- ❍ Other (e.g. servant) (16)

Answer If Relationship to head of household (Any Loop) Other (e.g. servant) Is Selected

Q29 Specify his/ her relationship to the head of household.

Answer If Gender Female Is Selected And What is ${q://QID26/ChoiceTextEntryValue/2}'s age? If under 1 year, enter 0. Text Response Is Greater Than or Equal to 15

Q30 Is ${q://QID26/ChoiceTextEntryValue/1} currently pregnant?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Answer If Gender Female Is Selected And What is ${q://QID26/ChoiceTextEntryValue/2}'s age? If under 1 year, enter 0. Text Response Is Greater Than or Equal to 15

Q31 Is ${q://QID26/ChoiceTextEntryValue/1} currently breastfeeding?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Answer If Is ${q://QID26/ChoiceTextEntryValue/2} currently breastfeeding? Yes Is Selected

Q32 Please tell me the age (months) of each child she is breastfeeding.

First child (1)
Second child (2)
Third child (3)

Q33 What is the highest level of education ${q://QID26/ChoiceTextEntryValue/1} completed?

- ❍ None (1)
- ❍ Class 1 (2)
- ❍ Class 2 (3)
- ❍ Class 3 (4)
- ❍ Class 4 (5)
- ❍ Class 5 (6)
- ❍ Class 6 (7)
- ❍ Class 7 (8)
- ❍ Class 8 (9)
- ❍ Class 9 (10)
- ❍ Class 10 (17)
- ❍ SSC Pass (11)
- ❍ HSC Pass (12)
- ❍ Graduate (13)
- ❍ Post-graduate (14)
- ❍ Medical (15)
- ❍ Vocational/Technical education (16)

Answer If What is ${q://QID26/ChoiceTextEntryValue/2}'s age? Text Response Is Greater Than or Equal to 10

Q34 How often does ${q://QID26/ChoiceTextEntryValue/1} go to the market to purchase food for the household?

- ❍ Always (11)
- ❍ Most of the time (12)
- ❍ About half the time (13)
- ❍ Sometimes (14)
- ❍ Never (15)

Q35 Thank you for the information about your household members. Now I have a few more questions about you.

Answer If Gender Female Is Selected

Q36 Are you currently pregnant?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Answer If Gender Female Is Selected

Q37 Are you currently breastfeeding?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you currently breastfeeding? Yes Is Selected

Q38 Please tell me the age (months) of each child you are breastfeeding.

First child (1)
Second child (2)
Third child (3)

Q39 What religion are you?
- ❍ Islam (1)
- ❍ Hindu (2)
- ❍ Buddhist (3)
- ❍ Christian (4)
- ❍ Other (5) _____
- ❍ N/A (6)

Answer If What religion are you? Other Is Selected

Q40 Specify religion.

Q41 In the last year, did anyone in your household ever do any work for which he or she was paid on a daily basis?
- ❍ Yes (1)
- ❍ No (2)

Q42 How many months were you employed in the last year?

Q43 What was your monthly income (BDT)?

Q44 What is your monthly household income (BDT)? Include income from all household members.

Q45 What is your annual household income (BDT)? Include income from all household members.

Q46 Are you the person who usually goes to the market to purchase food for the household?
- ❍ Always (11)
- ❍ Most of the time (12)
- ❍ About half the time (13)
- ❍ Sometimes (14)
- ❍ Never (15)

Q47 Next I will ask some questions about your household assets and agriculture production.

Q48 What type of latrine does the household use?
- ❍ Open field (1)
- ❍ Kacha latrine (temporary or permanent) (2)
- ❍ Pacca (pit or water seal) (3)
- ❍ Sanitary (4)

Q49 How many rooms does the household occupy (excluding rooms used for business)?

Q50 What is the main construction material of the walls of the main room in the home?
- ❍ Tile/wood (1)
- ❍ Hemp/hay/bamboo (2)
- ❍ C.I. sheet (3)
- ❍ Cement (4)

Q51 Does the household own a television?
- ❍ Yes (1)
- ❍ No (2)

Q52 How many fans does the household own?

Q53 How many mobile phones does the household own?

Q54 Does the household own any bicycles, motorcycles/scooters, or motor cars, etc.?
- ❍ Yes (1)
- ❍ No (2)

Q55 How much land does the household own? Specify for each land use.

	Cultivable land (currently cropped or fallow) (1)	Dwelling-house/homestead (2)	Non-cultivated land (not including homestead) (3)
Land Owned (Decimals) (1)			

Q56 How much additional cultivable land is rented/sharecropped/mortgaged - in or -out by the household? (excluding uncultivable land and dwelling-house/homestead land)

	Rented/sharecropped/morgaged-IN (2)	Rented/sharecropped/mortgaged-OUT (4)
Additional Cultivable Land (Decimals) (1)		

Q57 How much total land does the household have access to? (Decimals)Note: Verify that this equals the sum of the total land owned plus additional cultivable land.

Q58 Did your household produce any cereal crops in the last year? (Mark all that apply)
- ❑ Rice (Aus, Aman, and/or Boro) (1)
- ❑ Maize (2)
- ❑ Wheat (3)
- ❑ Other (4) _____
- ❑ Other (5) _____
- ❑ No cereal (6)

Q59 Count the number of cereal crops produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (6)
- ❍ 2 (7)
- ❍ 3 (8)
- ❍ 4 (9)
- ❍ 5 (10)

Q60 Type of cereal

Q61 What was the total area planted for ${q://QID155/ChoiceTextEntryValue/1} in the last year? (Decimals)

Q62 How much ${q://QID155/ChoiceTextEntryValue/1} did you produce in the last year?

Q63 Units of production
- ❍ Kilograms (2)
- ❍ Other (3) _____

Q64 How much ${q://QID155/ChoiceTextEntryValue/1} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q65 Did your household produce any vegetables in the last year? (Mark all that apply)

- ❑ Pumpkin (1)
- ❑ Bitter gourd (2)
- ❑ Bottle gourd (3)
- ❑ Eggplant (21)
- ❑ White potato (4)
- ❑ Sweet potato (orange) (5)
- ❑ Tomato (6)
- ❑ Cucumber (7)
- ❑ Red amaranth (8)
- ❑ Amaranth (9)
- ❑ Spinach (10)
- ❑ Cauliflower (11)
- ❑ Cabbage (12)
- ❑ Okra (13)
- ❑ Chili pepper (14)
- ❑ Onion (15)
- ❑ Turnips (16)
- ❑ Taro (17)
- ❑ Other (18) _____
- ❑ Other (19) _____
- ❑ No vegetables (20)

Q66 Count the number of vegetable crops produced in the last year and confirm with the respondent

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10 (11)
- ❍ 11 (12)
- ❍ 12 (13)
- ❍ 13 (14)
- ❍ 14 (15)
- ❍ 15 (16)
- ❍ 16 (17)
- ❍ 17 (18)
- ❍ 18 (19)
- ❍ 19 (20)

Q67 Type of vegetable

Q68 Is this vegetable mixed crop with other vegetables?

- ❍ Yes (1)
- ❍ No (2)

Answer If Is this vegetable mixed crop with other vegetables? Yes Is Selected

Q69 In your mixed crop plot of land, is ${q://QID163/ChoiceTextEntryValue} more or less than half of the area planted?

- ❍ More than half (1)
- ❍ About half (2)
- ❍ Less than half (3)

Q70 What was the total area planted for ${q://QID163/ChoiceTextEntryValue/2} in the last year? (Decimals)Note: If the vegetable is mixed crop, enter the approximate number of decimals allocated to this crop based on the previous question and the total land used for vegetables. (more than half, about half, less than half).

Q71 How much ${q://QID163/ChoiceTextEntryValue/2} did you produce in the last year?

Q72 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q73 How much ${q://QID163/ChoiceTextEntryValue/2} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q74 Did your household produce any pulses in the last year? (Mark all that apply)
- ❑ Lentils (1)
- ❑ Mung bean (2)
- ❑ Khesari (3)
- ❑ Other pulses (4) _____
- ❑ Other pulses (5) _____
- ❑ No pulses (6)

Q75 Count the number of pulses produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)

Q76 Type of pulse

Q77 What was the total area planted for ${q://QID221/ChoiceTextEntryValue/2} in the last year? (Decimals)

Q78 How much ${q://QID221/ChoiceTextEntryValue/2} did you produce in the last year?

Q79 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q80 How much ${q://QID221/ChoiceTextEntryValue/2} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q81 Did your household produce any fruit in the last year? (Mark all that apply)
- ❑ Mango (1)
- ❑ Jujube (2)
- ❑ Jackfruit (3)
- ❑ Litchi (4)
- ❑ Guava (5)
- ❑ Papaya (6)
- ❑ Coconut (7)
- ❑ Banana (8)
- ❑ Other (9) _____
- ❑ Other (10) _____
- ❑ Other (11) _____
- ❑ No fruits (12)

Q82 Count the number of fruits produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10 (11)
- ❍ 11 (12)

Q83 Type of fruit

Q84 How many ${q://QID231/ChoiceTextEntryValue} trees produced fruit in the last year?

Q85 How much ${q://QID231/ChoiceTextEntryValue} did you produce in the last year?

Q86 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q87 How much ${q://QID231/ChoiceTextEntryValue} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q88 Did your household produce any oilseed crops in the last year? (Mark all that apply)
- ❑ Mustard (1)
- ❑ Peanut (2)
- ❑ Soybean (3)
- ❑ Sesame (4)
- ❑ Other (5) _____
- ❑ Other (6) _____
- ❑ Other (7) _____
- ❑ No oilseeds (8)

Q89 Count the number of oilseed crops produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)

Q90 Type of oilseed

Q91 What was the total area planted for ${q://QID239/ChoiceTextEntryValue} in the last year? (Decimals)

Q92 How much ${q://QID239/ChoiceTextEntryValue} did you produce in the last year?

Q93 Units of production
❍ Kilograms (2)

Q94 How much ${q://QID239/ChoiceTextEntryValue} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q95 Did your household produce any fibrous crops in the last year? (Mark all that apply)
❑ Jute (1)
❑ Kenaf (8)
❑ Mesta (2)
❑ Other (5) _____
❑ Other (6) _____
❑ Other (7) _____
❑ No fibrous crops (13)

Q96 Count the number of fibrous crops produced in the last year and confirm with the respondent.
❍ 0 (1)
❍ 1 (2)
❍ 2 (3)
❍ 3 (4)
❍ 4 (5)
❍ 5 (6)
❍ 6 (7)

Q97 Type of fibrous crop

Q98 What was the total area planted for ${q://QID247/ChoiceTextEntryValue} in the last year? (Decimals)

Q99 How much ${q://QID247/ChoiceTextEntryValue} did you produce in the last year?

Q100 Units of production
❍ Kilograms (2)

Q101 How much ${q://QID247/ChoiceTextEntryValue} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q102 Did your household raise any livestock for production in the last year? If yes, what animal products did you produce? (Mark all that apply)

- ❑ Cow milk (1)
- ❑ Cow meat (beef) (13)
- ❑ Chicken meat (5)
- ❑ Chicken eggs (14)
- ❑ Duck meat (15)
- ❑ Duck eggs (6)
- ❑ Goat milk (7)
- ❑ Goat meat (8)
- ❑ Pigeon meat (9)
- ❑ Other (10) _____
- ❑ Other (4) _____
- ❑ Other (11) _____
- ❑ No livestock (12)

Q103 Count the number of animal products the household produced in the last year and confirm with the respondent.

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)

Q104 Type of animal product Note: Be specific about animal type. If milk, specify cow or goat. If eggs, specify chicken or duck.

Animal product (1)

Q105 How many animals did you have for producing ${q://QID169/ChoiceTextEntryValue/1} in the last year?

Q106 How much ${q://QID169/ChoiceTextEntryValue/1} did you produce in the last year?

Q107 Units of production
- ❍ Kilograms (1)
- ❍ Liters (2)
- ❍ Pieces (3)

Q108 How much ${q://QID169/ChoiceTextEntryValue/1} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Sold (1)	Kept for home consumption (2)
Product (1)		

Q109 Did your household cultivate any fish last year? (Mark all that apply)
- ❑ Rui (23)
- ❑ Katla (25)
- ❑ Carp (26)
- ❑ Tilapia (27)
- ❑ Koi (28)
- ❑ Mola (29)
- ❑ Shrimp (30)
- ❑ Prawn (31)
- ❑ Other (32) _____
- ❑ Other (33) _____
- ❑ Other (34) _____
- ❑ No fish (24)

Q110 Count the number of fish species cultivated in the last year and confirm with the respondent.

Q111 Type of fish
Species (1)

Q112 How much ${q://QID187/ChoiceTextEntryValue/1} did you produce in the last year?

Q113 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q114 How much ${q://QID187/ChoiceTextEntryValue/1} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given in the previous question about total production.

	Sold (1)	Kept for home consumption (2)
Product (1)		

Q115 Are you the person who normally prepares food for the household?
- ❍ Yes (1)
- ❍ No (2)

Answer If Are you the person who normally prepares food for the household? No Is Selected

Q116 In your household, who normally prepares food? Note: if the respondent answers the name of the person, clarify that person's relationship to the head of household.
- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Answer If In your household, who normally prepares food?;Note: if the respondent answers the name of the person, clarify that person's relationship to the head of household. Other (e.g. servant) Is Selected

Q117 Specify other who prepares the food for the household.

Q118 Please describe the foods (meals and other snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink in the morning.

Breakfast (1)
Snack (2)
Lunch (3)
Snack (4)
Dinner (5)

Q119 When the respondent recall of meals consumed in the last 24 hours is complete, fill in the food groups consumed by the respondent based on the information recorded above. Remember to ask whether that meal was consumed inside the home or outside of the home. For any food groups not mentioned in the meals and snacks, prompt the respondent by asking if he or she consumed a food item from this group. If the respondent has not consumed a food group, ask if anyone in the household consumed food items from that food group in the last 24 hours.

	Has anyone in the household consumed?					Did the respondent consume?			
	Yes inside the home (1)	Yes outside the home (2)	Inside and outside the home (3)	Unsure (4)	No (5)	Yes inside the home (1)	Yes outside the home (2)	Inside and outside the home (3)	No (4)
Cereals (rice, bread, wheat, rice flakes, puffed rice, barley, biscuits, popcorn)	❍	❍	❍	❍	❍	❍	❍	❍	❍
White roots and tubers (white potatoes, turnips)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Vitamin A rich vegetables and tubers (pumpkin, carrots, squash, orange-flesh sweet potatoes)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Dark leafy green vegetables (amaranth, spinach, taro leaf, pumpkin leaf, jute leaf)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other vegetables (cucumber, radish, pepper,	❍	❍	❍	❍	❍	❍	❍	❍	❍

cabbage, beans, cauliflower, onion)									
Vitamin A rich fruits (ripe papaya, ripe mangos, orange, grapefruit)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other fruits (banana, apple, jackfruit, watermelon, guava, plums, pineapple, melons, lemons, lychees)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Meat (chicken, beef, poultry, lamb, liver, kidney)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Eggs	❍	❍	❍	❍	❍	❍	❍	❍	❍
Fish and seafood	❍	❍	❍	❍	❍	❍	❍	❍	❍
Legumes, nuts, and seeds (lentils, dal, black gram, kheshari, mung beans)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Milk and milk products (cow milk, goat milk,	❍	❍	❍	❍	❍	❍	❍	❍	❍

powdered milk, yogurt, curd, cheese)									
Oils and fats (butter, ghee, mustard oil, soybean oil)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Sweets (sugar, honey, molasses, chocolate, ice cream, soda)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Spices, condiments, beverages (black pepper, salt, fish powder, chili sauce, cumin, chili)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q120 Now I would like to ask you about all of the different foods your household members have eaten in the last 7 days. Could you please tell me how many days in the past week your household has eaten the following foods? This can be inside the home or outside the home. (Enter a number 0-7) Please note your primary and secondary source for each food item.

	Number of DAYS eaten in the past week. (0-7)	Primary Source	Secondary Source
Cereals (rice, bread, wheat, rice flakes, puffed rice, barley, biscuits, popcorn) (1)			
White roots and tubers (white potatoes, turnips) (2)			
Vitamin A rich vegetables and tubers (pumpkin, carrots, squash, orange-flesh sweet potatoes) (3)			
Dark leafy green vegetables (amaranth, spinach, taro leaf, pumpkin leaf, jute leaf) (4)			
Other vegetables (cucumber, radish, pepper, cabbage, beans, cauliflower, onion) (5)			
Vitamin A rich fruits (ripe papaya, ripe mango, orange, grapefruit) (6)			
Other fruits (banana, apple, jackfruit, watermelon, guava, plums, pineapple, melons, lemons, lychees) (7)			
Meat (chicken, beef, poultry, lamb, liver, kidney) (8)			
Eggs (9)			
Fish and seafood (10)			
Legumes, nuts, and seeds (lentils, dal, black gram, kheshari, mung beans) (11)			
Milk and milk products			

(cow milk, goat milk, powdered milk, yogurt, curd, cheese) (12) Oils and fats (butter, ghee, mustard oil, soybean oil) (13) Sweets (sugar, honey, molasses, chocolate, ice cream, soda) (14) Spices, condiments, beverages (black pepper, salt, fish powder, soy sauce, chili sauce, cumin, chili powder, cinnamon, coffee, tea) (15)			

Q122 I am going to ask you some questions about nutrition, vitamins and food. This is a survey, not a test. Your answers will help identify which dietary advice people find confusing. Please let me know if you need me to clarify any of my questions. Feel free to ask me any questions you may have. If you do not know the answer, it is ok to respond "I don't know."

Q123 Do you think that health experts recommend that people should be eating more, the same amount, or less of these foods? (Mark one box per food)

	More (1)	Same (2)	Less (3)	I don't know (4)
Vegetables (1)	❍	❍	❍	❍
Sweets (2)	❍	❍	❍	❍
Meat (3)	❍	❍	❍	❍
Carbohydrates (4)	❍	❍	❍	❍
Fatty foods (5)	❍	❍	❍	❍
High fibre foods (6)	❍	❍	❍	❍
Fruit (7)	❍	❍	❍	❍
Salty foods (8)	❍	❍	❍	❍

Q124 How many servings of fruits and vegetables per day do you think experts are advising people to eat? (One serving could be, for example, an apple or a spoonful of cucumbers). The response should be in number of times per day/servings, not grams.

Q125 Experts classify food into groups. We are interested to see whether people are aware of what foods are in these groups.

Q126 Do you think the following foods are high or low in vitamin A?

	High (1)	Low (2)	Unsure (3)
Carrot (1)	❍	❍	❍
Banana (27)	❍	❍	❍
Rice (28)	❍	❍	❍
Wheat flour (47)	❍	❍	❍
Mola fish (49)	❍	❍	❍
Leafy greens (spinach, amaranth) (50)	❍	❍	❍

Q127 Do you think experts put these foods in the carbohydrates group?

	Yes (1)	No (2)	Unsure (3)
Rice (1)	❍	❍	❍
Potatoes (3)	❍	❍	❍
Sweet potatoes (4)	❍	❍	❍
Chapati (5)	❍	❍	❍
Biscuits (6)	❍	❍	❍

Q128 Do you think these foods are high or low in protein?

	High (1)	Low (2)	Unsure (3)
Chicken (1)	❍	❍	❍
Fish (2)	❍	❍	❍
Egg (3)	❍	❍	❍
Pulses (4)	❍	❍	❍
Milk (5)	❍	❍	❍
Fruit (6)	❍	❍	❍
Rice (7)	❍	❍	❍

Q129 Are you aware of any major health problems or diseases that are related to a low intake of fruits and vegetables?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Answer If Are you aware of any major health problems or diseases that are related to a low intake of fruits and vegetables? Yes Is Selected

Q130 What diseases or health problems do you think are related to a low intake of fruits and vegetables?

Q131 Are you aware of any major health problems or diseases that are related to how much sugar people eat?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Q132 What diseases or health problems do you think are related to sugar?

Q133 Are you aware of any major health problems or diseases that are related to the amount of fat people eat?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Q134 What diseases or health problems do you think are related to fat?

Q135 Now I am going to ask you some questions about nutrition for pregnant and lactating women. Please let me know if you need me to clarify any of my questions. Feel free to ask me any questions you may have. If you do not know the answer, it is ok to respond "I don't know."

Q136 How should a pregnant woman eat in comparison to a non-pregnant woman to provide good nutrition to her baby to help him or her grow? Please list 4 practices she should do. Mark only the answers that the respondent names. Do not read these choices to the respondent.

- ❑ Eat more food / more energy (1)
- ❑ Eat more protein-rich foods (2)
- ❑ Eat more iron-rich foods (3)
- ❑ Use iodized salt when preparing meals (4)
- ❑ Other (5) _____
- ❑ I don't know (6)

Q137 Are there common supplements, or tablets, recommended to women during pregnancy? If so, can you name them? Mark only the answers that the respondent names. Do not read these choices to the respondent.

- ❑ Iron supplements (1)
- ❑ Folic acid supplements (2)
- ❑ None (5)
- ❑ Other (3)
- ❑ I don't know (4)

Q138 How should a lactating woman eat in comparison with a non-lactating woman to be healthy and produce more breastmilk? Mark only the answers that the respondent names. Do not read these choices to the respondent.

- ❑ Eat more food / more energy (1)
- ❑ Eat more protein-rich foods (2)
- ❑ Eat more iron-rich foods (3)
- ❑ Use iodized salt when preparing meals (4)
- ❑ Other (5)
- ❑ I don't know (6)

Q139 Now I have some questions about breastfeeding practices and infant and child nutrition. Please let me know if you need me to clarify any of my questions. Feel free to ask me any questions you may have. If you do not know the answer, it is ok to respond "I don't know."

Q140 How long should a baby receive nothing but breastmilk?Probe if necessary: Until what age is it recommended that a mother feeds nothing more than breastmilk?

- ❍ From birth to 6 months (1)
- ❍ From birth to 11 months (2)
- ❍ Other (3)
- ❍ I don't know (4)

Q141 How long is it recommended that a woman breastfeeds her child?Probe if necessary: Until what age is it recommended that a mother continues breastfeeding?

- ❑ Six months or less (1)
- ❑ 6-11 months (2)
- ❑ 12-24 months (3)
- ❑ More than 24 months (4)
- ❑ Other (5)
- ❑ I don't know (6)

Q142 Now I have some questions for you about food purchases and agriculture markets.

Q143 Are you the person who makes the final decision about food purchases and preparation?
- ❍ Yes (1)
- ❍ No (2)

Answer If Are you the person who makes the final decision about food purchases and preparation? No Is Selected

Q144 Who makes the final decision regarding food purchases and preparation?
- ❍ Head of household (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Daughter-in-law (8)
- ❍ Son-in-law (9)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Father-in-law/Mother-in-law (12)
- ❍ Nephew/Niece (13)
- ❍ Grandfather/Grandmother (14)
- ❍ Sister-in-law/Brother-in-law (15)
- ❍ Brother's wife (16)
- ❍ Other (e.g. servant) (17)

Q145 If you had more income, would you spend more of your money on food?
- ❍ Yes (1)
- ❍ No (2)

Q146 If you had more money available to spend on food would you consume the same types of food?
- ❍ Yes (1)
- ❍ No (2)

Q147 If you had more money available to spend on food, which of the following would you consume more of? (Mark all that apply)
- ❑ Cereals (1)
- ❑ Pulses (2)
- ❑ Vegetables (3)
- ❑ Fruits (4)
- ❑ Meat (5)
- ❑ Eggs (6)
- ❑ Fish (7)
- ❑ Milk or milk products (8)
- ❑ Sweets (9)
- ❑ Other foods (10) _____
- ❑ I would not spend more money on food. (11)

Q148 Did anyone in your household buy any food (from a market) to cook in the household in the last year?

- ❍ Yes (1)
- ❍ No (2)

Answer If Did anyone in your household buy any food (from a market) to cook in the household in the last year? Yes Is Selected

Q149 How long does it take to walk to a place to buy food?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)

Answer If Did anyone in your household buy any food (from a market) to cook in the household in the last year? Yes Is Selected

Q150 What mode of transportation does your household use to go to the market for buying food?

- ❍ By foot (1)
- ❍ By bicycle (2)
- ❍ By rickshaw/van (3)
- ❍ By car/truck (4)
- ❍ By motorcycle (5)
- ❍ By boat (6)
- ❍ Other (7) _____

Answer If Did anyone in your household buy any food (from a market) to cook in the household in the last ye... Yes Is Selected

Q151 How much does this transportation cost per trip to the market? (BDT)

Q152 Does anyone in your household ever sell commercial agricultural products grown in your household (e.g. rice, maize)?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell commercial agricultural products grown in your household (e.g. rice, maize)? Yes Is Selected

Q153 How long does it take to walk to the place to sell commercial agricultural products, for example to a market or buyer pick-up location?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell commercial agricultural products grown in your household? Yes Is Selected

Q154 Who controls the income from sales of commercial agricultural products? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q155 Does anyone in your household ever sell vegetables or fruits grown in your household? (e.g. pumpkins, cucumbers, mangos)

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell vegetables or fruits grown in your household? (e.g. pumpkins, cucumbers, mangos) Yes Is Selected

Q156 How long does it take to walk to the place to sell vegetables or fruits?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell vegetables or fruits grown in your household? Yes Is Selected

Q157 Who controls the income from the sales of vegetables/fruits? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q158 Does anyone in your household ever sell fish produced in your household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell fish produced in your household?; Yes Is Selected

Q159 How long does it take to walk to the place to sell fish?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Q160 Does anyone in your household ever sell animal protein (meat) produced in your household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell animal protein (meat) produced in your household? Yes Is Selected

Q161 How long does it take to walk to the place to sell animal protein (meat)?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell animal protein (meat) produced in your household? Yes Is Selected

Q162 Who controls the income from the animal protein (meat)? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q163 Does anyone in your household ever sell eggs produced in your household?

- ❍ Yes (1)
- ❍ No (3)

Answer If Does anyone in your household ever sell eggs produced in your household? Yes Is Selected

Q164 How long does it take to walk to the place to sell eggs?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell eggs produced in your household? Yes Is Selected

Q165 Who controls the income from the sale of eggs? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17) _____

Q166 Does anyone in your household ever sell milk or milk products produced in the household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell milk or milk products produced in the household? Yes Is Selected

Q167 How long does it take to walk to the place to sell milk or milk products?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell milk or milk products produced in the household? Yes Is Selected

Q168 Who controls the income from the sale of milk or milk products? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17) _____

Answer If Yes Was Selected for Sale of Any Products.

Q169 What mode of transportation does your household use to transport agricultural goods, fish, or vegetables/fruits to the market/selling points?

- ❍ By foot (1)
- ❍ By bicycle (2)
- ❍ By rickshaw/van (3)
- ❍ By car/truck (4)
- ❍ By motorcycle (5)
- ❍ By boat (6)
- ❍ Other (7) _____

Q170 Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs?

- ❍ Yes (1)
- ❍ No (2)

Answer If Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs? Yes Is Selected

Q171 During which months did you not have enough food to meet your family's needs? (Check all that apply)

- ❑ January (1)
- ❑ February (2)
- ❑ March (3)
- ❑ April (4)
- ❑ May (5)
- ❑ June (6)
- ❑ July (7)
- ❑ August (8)
- ❑ September (9)
- ❑ October (10)
- ❑ November (11)
- ❑ December (12)

Q172 In the past four weeks, did you worry that your household would not have enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you worry that your household would not have enough food? Yes Is Selected

Q173 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q174 In the past four weeks were you or any household member not able to eat the kinds of food you preferred because of a lack of resources to get food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks were you or any household member not able to eat the kinds of food you preferred because of a lack of resources to get food? Yes Is Selected

Q175 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q176 In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? Yes Is Selected

Q177 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q178 In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? Yes Is Selected

Q179 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q180 In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food? Yes Is Selected

Q181 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q182 In the past four weeks, was there ever no food of any kind in your household because of a lack of resources to get food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, was there ever no food of any kind in your household because of a lack of resources to get food? Yes Is Selected

Q183 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q184 In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food? Yes Is Selected

Q185 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q186 In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? Yes Is Selected

Q187 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q188 In the past 12 months, how often did you or any of your family have to eat potato, wheat, or another grain although you wanted to eat rice (not including when you were sick)?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q189 In the past 12 months, how often did you or any of your family skip entire meals due to scarcity of food?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q190 In the past 12 months, how often did you personally eat less food in a meal due to scarcity of food?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q191 In the past 12 months, how often did your family purchase food (rice, lentils, etc.) on credit or loan from a local shop?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q192 In the past 12 months, how often did your family have to borrow/take food from relatives or neighbors to make a meal?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

APPENDIX C
ENDLINE SURVEY

Q466 Please make sure the GPS locator is ON for your tablet.

Q1 Hello, my name is _____ and I am conducting research on behalf of the Bangladesh Agricultural University and the University of Florida. We are contacting you to follow up on our research about household food availability and access. This research is for a doctoral dissertation at the University of Florida in the United States of America. First of all, I would like to thank you for taking the time to meet with me. We would like to ask you some questions about the _____(BAUEC/Sushilan) event you attended and your food consumption and diet. This interview should take approximately 30 minutes to 1 hour. Your participation in this study will be confidential to the extent provided by law, and your responses and comments will be anonymous. There are no direct benefits, risks, or compensation to you for participating in this study. Participation is completely voluntary, and you may withdraw your consent to participate at any time without penalty.

Q3 I will be asking questions about your household members and yourself, your household income, agricultural production, food availability and access. Your responses will be completely private and will only be connected with your name through an identification number. We understand that you may not have all of the precise information available. It is important for the information in this study to be as accurate as possible. Please try to answer as many questions as you can, but if you cannot remember some information, it is ok to answer 'I do not remember'. Finally, you have the right to not answer any question we might ask. You may also choose to stop answering questions at any time. If you do, we will not collect any more information from you. However, we would keep and use the information we had already collected from you.

Q4 Given this information, are you willing to participate in this survey?
- ❍ Yes (1)
- ❍ No (2)

Q359 Did you attend the _____ (BAUEC/Sushilan) event and meal?
- ❍ Yes (1)
- ❍ No (2)

Answer If Given this information, are you willing to participate in this survey? No Is Selected

Q358 For our records, can you tell us why you do not want to participate? Note to interviewer: please remind the respondent about the privacy of their responses and that the individual does not have to know all of the answers. The study is anonymous. Will you reconsider?
- ❍ Yes (1)
- ❍ No (2)

Q5 Enumerator Name (Last name, First name)

- ❍ Afroza (2)
- ❍ Alamin (17)
- ❍ Ame (4)
- ❍ Anik (6)
- ❍ Anup (7)
- ❍ Ayesha (8)
- ❍ Azil (9)
- ❍ Diti (37)
- ❍ Eva (10)
- ❍ Himu (11)
- ❍ Jenny (12)
- ❍ Mahmud (14)
- ❍ Mumu (15)
- ❍ Nilima (39)
- ❍ Nosib (3)
- ❍ Pinkey (18)
- ❍ Prodip (19)
- ❍ Rabbi (20)
- ❍ Rubyeat (21)
- ❍ Sadia (Urvi) (24)
- ❍ Sajib (22)
- ❍ Shakir (25)
- ❍ Shaon (26)
- ❍ Shatabdi (36)
- ❍ Shirin (38)
- ❍ Shoaib (31)
- ❍ Shuvo (27)
- ❍ Tapoti (35)
- ❍ Tania (29)
- ❍ Wahidul (28)

Q467 GPS Coordinates Please enter the coordinates from the "Simple GPS Coordinate Display" app installed on your tablet.

Latitude (1)
Longitude (2)

Q6 District

- ❍ Mymensingh (1)
- ❍ Borguna (2)

Q7 Upazila

- ❍ Mymensingh Sadar (1)
- ❍ Amtoli (2)

Q8 Union

- ❍ Chowra (1)
- ❍ Holdia (2)

Answer If District Borguna Is Selected

Q9 Sushilan Village

- ❍ Baitakata (1)
- ❍ Baitmore (2)
- ❍ Chalavanga (3)
- ❍ Chandra (4)
- ❍ Chandra Kapali (5)
- ❍ Ghatkhali (6)
- ❍ Gilatali (7)
- ❍ Holdia (8)
- ❍ Holodia (Paka) (9)
- ❍ Holodia (10)
- ❍ Kalibari (11)
- ❍ Kawnia (12)
- ❍ Kawnia Kapali (13)
- ❍ Loda (14)
- ❍ Patakata (15)
- ❍ Patakata midle (16)
- ❍ Uttar Tokta Bunia (17)

Answer If District Mymensingh Is Selected

Q316 BAU Village

- ❍ Boira moddopara sorkar bari (1)
- ❍ Boira mosque (2)
- ❍ Borobilarpar (3)
- ❍ Bot tola bazar (4)
- ❍ Bot tola hatem bapari (5)
- ❍ Chor nilokkhai ujanpara (6)
- ❍ Chorkalibari shomvuganj (7)
- ❍ Chornillokhia digolpara (8)
- ❍ Goneshampur (9)
- ❍ Gosta north (10)
- ❍ Jhaugau (11)
- ❍ Jogir ali chor nilokkhia (12)
- ❍ Kismat khagdohor (13)
- ❍ Maijbari (14)
- ❍ Mirjapur east (15)
- ❍ Mirjapur north (16)
- ❍ Mirjapur south (17)
- ❍ Muktijodda bazar chor (18)
- ❍ Mukhtijoddha bazar jogir algi (19)
- ❍ Pagla Bazaar (20)
- ❍ Pagla bazar kazi bari (21)
- ❍ Pagla bazar mojiborer bari (22)
- ❍ Ragobpur (23)
- ❍ Sathiapara (24)
- ❍ Sathiapra chor nillokkhia (25)
- ❍ Shailmari purrush (26)
- ❍ Suhila moddopara (27)
- ❍ Suhila nodir par (28)
- ❍ Suhila north (29)
- ❍ Sutiakhali middle (30)
- ❍ Sutiakhali palpara 1 (31)
- ❍ Sutiakhali palpara 2 (32)
- ❍ Vabokhali pwest (33)
- ❍ Vabukhali (34)

Q317 BHH Code (Sushilan) or S.I. Number (BAUEC)

Q473 Participant meal ID number

Q10 Thank you for participating in this study. I would like to start by asking some questions about you and your household members.

Q11 Respondent Name

First name (1)
Last name (2)
Father/Husband name (3)

Q12 Do you have a mobile number where we can reach you? If so, what is your number?

Q13 Gender

- ❍ Male (1)
- ❍ Female (2)

Q14 Are you the head of household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you the head of household? No Is Selected

Q15 What is your relationship to the head of household?

- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Daughter-in-law/Son-in-law (8)
- ❍ Brother/Sister (9)
- ❍ Father-in-law/Mother-in-law (10)
- ❍ Nephew/Niece (11)
- ❍ Grandfather/Grandmother (12)
- ❍ Grandson/Granddaughter (13)
- ❍ Sister-in-law/Brother-in-law (14)
- ❍ Brother's wife (15)
- ❍ Other (e.g. servant) (16)

Q16 What is your marital status?

- ❍ Married (1)
- ❍ Single (never married) (2)
- ❍ Widowed (3)
- ❍ Divorced (5)
- ❍ Separated (4)

Q17 What is your age?

Q18 What is the highest level of education you have completed?

- ❍ None (1)
- ❍ Class 1 (2)
- ❍ Class 2 (3)
- ❍ Class 3 (4)
- ❍ Class 4 (5)
- ❍ Class 5 (6)
- ❍ Class 6 (7)
- ❍ Class 7 (8)
- ❍ Class 8 (9)
- ❍ Class 9 (10)
- ❍ Class 10 (17)
- ❍ SSC Pass (11)
- ❍ HSC Pass (12)
- ❍ Graduate (13)
- ❍ Post-graduate (14)
- ❍ Medical (15)
- ❍ Vocational/Technical education (16)

Q19 What is your primary occupation?

- ❍ Farming (own land) (1)
- ❍ Poultry and livestock rearing (2)
- ❍ Sharecropper (3)
- ❍ Agricultural day labor/contract labor (4)
- ❍ Fishing (own boat) (5)
- ❍ Fishing labor (someone else's boat) (6)
- ❍ Fish farming (7)
- ❍ Boat operation (8)
- ❍ Rickshaw/van operator (9)
- ❍ Casual labor (10)
- ❍ Self-employed in business/petty business (11)
- ❍ Non-agricultural day labor/contract labor (12)
- ❍ Regular salaried employment (13)
- ❍ Paid "volunteer" (14)
- ❍ Housework (child care/home care) (15)
- ❍ Servant/maid (16)
- ❍ Student (17)
- ❍ Beggar (18)
- ❍ Unemployed (19)
- ❍ Old/Disabled (20)
- ❍ Other (21) _____
- ❍ N/A (22)

Answer If Primary occupation Other Is Selected

Q20 Specify your primary occupation.

Q21 What is your secondary occupation?Farming (own land) (1)

- ❍ Poultry and livestock rearing (2)
- ❍ Sharecropper (3)
- ❍ Agricultural day labor/contract labor (4)
- ❍ Fishing (own boat) (5)
- ❍ Fishing labor (someone else's boat) (6)
- ❍ Fish farming (7)
- ❍ Boat operation (8)
- ❍ Rickshaw/van operator (9)
- ❍ Casual labor (10)
- ❍ Self-employed in business/petty business (11)
- ❍ Non-agricultural day labor/contract labor (12)
- ❍ Regular salaried employment (13)
- ❍ Paid "volunteer" (14)
- ❍ Housework (child care/home care) (15)
- ❍ Servant/maid (16)
- ❍ Student (17)
- ❍ Beggar (18)
- ❍ Unemployed (19)
- ❍ Old/Disabled (20)
- ❍ Other (21) _____
- ❍ N/A (22)

Answer If Secondary occupation Other Is Selected

Q22 Specify your secondary occupation.

Q23 Now I would like to ask some questions about your household members.How many individuals, NOT including yourself, live in your household? Please include the people who habitually eat and sleep in the home, including those who have been absent less than six months and have not established another residence. This includes maids or servants who live in the household.

- ❍ 0 (21)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)
- ❍ 11 (11)
- ❍ 12 (12)
- ❍ 13 (13)
- ❍ 14 (14)
- ❍ 15 (15)
- ❍ 16 (16)
- ❍ 17 (17)
- ❍ 18 (18)
- ❍ 19 (19)
- ❍ 20 (20)

Q360 In the last four months, has anyone in your household migrated/moved away?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the last four months, has anyone in your household migrated/moved away? Yes Is Selected

Q362 How many people moved away?

Q405 In the last four months, has any new member moved into your household?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the last four months, has any new member moved into your household? Yes Is Selected

Q406 How many people moved into your household?

Q381 Who moved away?

First Name (1)

Q361 What is ${q://QID406/ChoiceTextEntryValue/1}'s relationship to the head of household

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q444 What is ${q://QID406/ChoiceTextEntryValue/1}'s gender?

- ❍ Male (1)
- ❍ Female (2)

Q445 What is ${q://QID406/ChoiceTextEntryValue/1}'s age?

Q432 What is the name of the individual who moved into your household in the last four months?

First Name (1)

Q433 What is ${q://QID432/ChoiceTextEntryValue/1}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q447 What is ${q://QID432/ChoiceTextEntryValue/1}'s gender?

- ❍ Male (1)
- ❍ Female (2)

Q448 What is ${q://QID432/ChoiceTextEntryValue/1}'s age?

Q374 In the last four months, has any household member's level of education changed?

- ❍ Yes (1)
- ❍ No (2)

Q375 How many household members' level of education has changed?

Q380 Who completed a higher level of education?

Q378 What is ${q://QID405/ChoiceTextEntryValue}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q449 What is ${q://QID405/ChoiceTextEntryValue}'s gender?

- ❍ Male (1)
- ❍ Female (2)

Q450 What is ${q://QID405/ChoiceTextEntryValue}'s age?

Q379 What is the highest level of education ${q://QID405/ChoiceTextEntryValue} has completed?

- ❍ None (1)
- ❍ Class 1 (2)
- ❍ Class 2 (3)
- ❍ Class 3 (4)
- ❍ Class 4 (5)
- ❍ Class 5 (6)
- ❍ Class 6 (7)
- ❍ Class 7 (8)
- ❍ Class 8 (9)
- ❍ Class 9 (10)
- ❍ Class 10 (11)
- ❍ SSC Pass (13)
- ❍ HSC Pass (14)
- ❍ Graduate (15)
- ❍ Post-graduate (16)
- ❍ Medical (17)
- ❍ Vocational/Technical Education (18)

Q365 In the last four months, has anyone in your household gotten married?

- ❍ Yes (1)
- ❍ No (2)

Q382 How many household members got married in the last four months?

Q385 In the last four months, has anyone in your household gotten divorced or separated?
- ❍ Divorced (1)
- ❍ Separated (4)
- ❍ No (3)

Q386 How many household members got divorced or separated?

Q383 Who got married?
First Name (1)

Q367 What is ${q://QID408/ChoiceTextEntryValue/1}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q452 What is ${q://QID408/ChoiceTextEntryValue/1}'s gender?
- ❍ Male (1)
- ❍ Female (2)

Q451 What is ${q://QID408/ChoiceTextEntryValue/1}'s age?

Q384 Does ${q://QID408/ChoiceTextEntryValue/1} still live in your household?
- ❍ Yes (1)
- ❍ No (2)

Q387 Who got ${q://QID410/ChoiceGroup/SelectedChoices}?
First Name (1)

Q388 What is ${q://QID412/ChoiceTextEntryValue/1}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q453 What is ${q://QID412/ChoiceTextEntryValue/1}'s gender?
- ❍ Male (1)
- ❍ Female (2)

Q454 What is ${q://QID412/ChoiceTextEntryValue/1}'s age?

Q389 Does ${q://QID412/ChoiceTextEntryValue/1} still live in your household?
- ❍ Yes (1)
- ❍ No (2)

Q368 In the last four months, has anyone in your household had a baby?
- ❍ Yes (1)
- ❍ No (2)

Answer If In the last four months, has anyone in your household had a baby? Yes Is Selected

Q371 How many household members had a baby in the last four months?
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)

Q370 Who had a baby?
First name (1)

Q390 What is ${q://QID395/ChoiceTextEntryValue/1}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q455 What is ${q://QID395/ChoiceTextEntryValue/1}'s age?

Q372 How old is the baby now?

Q373 Is the mother breastfeeding the baby?
- ❍ Yes (1)
- ❍ No (2)

Q391 In the last four months, has any household member become pregnant?
- ❍ Yes (1)
- ❍ No (2)

Q392 How many household members became pregnant in the last four months?
- ❍ 0 (0)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)

Q393 Who became pregnant?
First name (1)

Q394 What is ${q://QID418/ChoiceTextEntryValue/1}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q456 What is ${q://QID418/ChoiceTextEntryValue/1}'s age?

Q395 In the last four months, have any of your household members died?
- ❍ Yes (1)
- ❍ No (2)

Q396 How many of your household members have died in the last four months?
- ❍ 0 (0)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 (6)
- ❍ 7 (7)
- ❍ 8 (8)
- ❍ 9 (9)
- ❍ 10 (10)

Q397 What is the name of the household member who died?

Q398 How old was ${q://QID422/ChoiceTextEntryValue}?

Q400 What is ${q://QID422/ChoiceTextEntryValue}'s relationship to the head of household?

- ❍ Household head (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Father-in-law (8)
- ❍ Mother-in-law (9)
- ❍ Daughter-in-law (22)
- ❍ Son-in-law (23)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Nephew (12)
- ❍ Niece (13)
- ❍ Grandfather (14)
- ❍ Grandmother (15)
- ❍ Grandson (16)
- ❍ Granddaughter (17)
- ❍ Sister-in-law (18)
- ❍ Brother-in-law (19)
- ❍ Brother's wife (20)
- ❍ Other (e.g. servant) (21)

Q457 What is ${q://QID422/ChoiceTextEntryValue}'s gender?

- ❍ Male (1)
- ❍ Female (2)

Q35 Thank you for the information about your household members. Now I have a few more questions about you.

Answer If Gender Female Is Selected

Q36 Are you currently pregnant?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Answer If Gender Female Is Selected

Q37 Are you currently breastfeeding?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you currently breastfeeding? Yes Is Selected

Q38 Please tell me the age (months) of each child you are breastfeeding.

First child (1)
Second child (2)
Third child (3)

Q403 How many children ages 6 to 12 years old currently live in your household?

Q404 How many children ages 6 to 12 years old currently attend a school or educational institution?

Q39 What religion are you?
- ❍ Islam (1)
- ❍ Hindu (2)
- ❍ Buddhist (3)
- ❍ Christian (4)
- ❍ Other (5) _____
- ❍ N/A (6)

Answer If What religion are you? Other Is Selected

Q40 Specify religion.

Q41 In the last year, did anyone in your household ever do any work for which he or she was paid on a daily basis?
- ❍ Yes (1)
- ❍ No (2)

Q42 How many months were you employed in the last year?

Q43 What was your monthly income (BDT)?

Q44 What is your monthly household income (BDT)? Include income from all household members.

Q45 What is your annual household income (BDT)? Include income from all household members.

Q46 Are you the person who usually goes to the market to purchase food for the household?
- ❍ Always (11)
- ❍ Most of the time (12)
- ❍ About half the time (13)
- ❍ Sometimes (14)
- ❍ Never (15)

Q409 Do any other household members usually go to the market to purchase food for the household?

	Member 1	Member 2	Member 3	Member 4
Head of household (1)	☐	☐	☐	☐
Wife of household head (2)	☐	☐	☐	☐
Husband of household head (3)	☐	☐	☐	☐
Son (4)	☐	☐	☐	☐
Daughter (5)	☐	☐	☐	☐
Father (6)	☐	☐	☐	☐
Mother (7)	☐	☐	☐	☐
Daughter-in-law (8)	☐	☐	☐	☐
Son-in-law (9)	☐	☐	☐	☐
Brother (10)	☐	☐	☐	☐
Sister (11)	☐	☐	☐	☐
Father-in-law (12)	☐	☐	☐	☐
Mother-in-law (13)	☐	☐	☐	☐
Nephew (14)	☐	☐	☐	☐
Niece (15)	☐	☐	☐	☐
Grandfather (16)	☐	☐	☐	☐
Grandmother (17)	☐	☐	☐	☐
Grandson (18)	☐	☐	☐	☐

Q47 Next I will ask some questions about your household assets and landholding.

Q48 What type of latrine does the household use?
- ❍ Open field (1)
- ❍ Kacha latrine (temporary or permanent) (2)
- ❍ Pacca (pit or water seal) (3)
- ❍ Sanitary (4)

Q49 How many rooms does the household occupy (excluding rooms used for business)?

Q50 What is the main construction material of the walls of the main room in the home?
- ❍ Tile/wood (1)
- ❍ Hemp/hay/bamboo (2)
- ❍ C.I. sheet (3)
- ❍ Cement (4)

Q51 Does the household own a television?
- ❍ Yes (1)
- ❍ No (2)

Q52 How many fans does the household own?

Q53 How many mobile phones does the household own?

Q54 Does the household own any bicycles, motorcycles/scooters, or motor cars, etc.?
- ❍ Yes (1)
- ❍ No (2)

Q55 How much land does the household own? Specify for each land use.

	Cultivable land (currently cropped or fallow) (1)	Dwelling-house/homestead (2)	Non-cultivated land (not including homestead) (3)
Land Owned (Decimals) (1)			

Q56 How much additional cultivable land is rented/sharecropped/mortgaged - in or -out by the household? (excluding uncultivable land and dwelling-house/homestead land)

	Rented/sharecropped/morgaged-IN (2)	Rented/sharecropped/mortgaged-OUT (4)
Additional Cultivable Land (Decimals) (1)		

Q57 How much total land does the household have access to? (Decimals)Note: Verify that this equals the sum of the total land owned plus additional cultivable land.

Q115 Are you the person who normally prepares food for the household?
- ❍ Yes (1)
- ❍ No (2)

Answer If Are you the person who normally prepares food for the household? No Is Selected

Q116 In your household, who normally prepares food? Note: if the respondent answers the name of the person, clarify that person's relationship to the head of household.
- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law (12)
- ❑ Mother-in-law (18)
- ❑ Nephew (13)
- ❑ Niece (19)
- ❑ Grandfather (14)
- ❑ Grandmother (20)
- ❑ Sister-in-law (15)
- ❑ Brother-in-law (21)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Answer If In your household, who normally prepares food? Note: if the respondent answers the name of the person, clarify that person's relationship to the head of household. Other (e.g. servant) Is Selected

Q117 Specify other who prepares the food for the household.

Q118 Please describe the foods (meals and other snacks) that you ate or drank yesterday during the day and night, whether at home or outside the home. Start with the first food or drink in the morning.

Breakfast (1)
Snack (2)
Lunch (3)
Snack (4)
Dinner (5)

Q119 When the respondent recall of meals consumed in the last 24 hours is complete, fill in the food groups consumed by the respondent based on the information recorded above. Remember to ask whether that meal was consumed inside the home or outside of the home. For any food groups not mentioned in the meals and snacks, prompt the respondent by asking if he or she consumed a food item from this group. If the respondent has not consumed a food group, ask if anyone in the household consumed food items from that food group in the last 24 hours.

	Has anyone in the household consumed?					Did the respondent consume?			
	Yes inside the home (1)	Yes outside the home (2)	Inside and outside the home (3)	Unsure (4)	No (5)	Yes inside the home (1)	Yes outside the home (2)	Inside and outside the home (3)	No (4)
Cereals (rice, bread, wheat, rice flakes, puffed rice, barley, biscuits, popcorn)	❍	❍	❍	❍	❍	❍	❍	❍	❍
White roots and tubers (white potatoes, turnips)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Vitamin A rich vegetables and tubers (pumpkin, carrots, squash, orange-flesh sweet potatoes)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Dark leafy green vegetables (amaranth, spinach, taro leaf, pumpkin leaf, jute leaf)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other vegetables (cucumber, radish, pepper,	❍	❍	❍	❍	❍	❍	❍	❍	❍

cabbage, beans, cauliflower, onion)									
Vitamin A rich fruits (ripe papaya, ripe mangos, orange, grapefruit)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other fruits (banana, apple, jackfruit, watermelon, guava, plums, pineapple, melons, lemons, lychees)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Meat (chicken, beef, poultry, lamb, liver, kidney)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Eggs	❍	❍	❍	❍	❍	❍	❍	❍	❍
Fish and seafood	❍	❍	❍	❍	❍	❍	❍	❍	❍
Legumes, nuts, and seeds (lentils, dal, black gram, kheshari, mung beans)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Milk and milk products (cow milk, goat milk,	❍	❍	❍	❍	❍	❍	❍	❍	❍

powdered milk, yogurt, curd, cheese)									
Oils and fats (butter, ghee, mustard oil, soybean oil)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Sweets (sugar, honey, molasses, chocolate, ice cream, soda)	❍	❍	❍	❍	❍	❍	❍	❍	❍
Spices, condiments, beverages (black pepper, salt, fish powder, soy sauce, chili sauce, cumin, chili powder, cinnamon, coffee, tea)	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q120 Now I would like to ask you about all of the different foods your household members have eaten in the last 7 days. Could you please tell me how many days in the past week your household has eaten the following foods? This can be inside the home or outside the home. (Enter a number 0-7)

	Number of DAYS eaten in the past week. (0-7)	Primary Source	Secondary Source
Cereals (rice, bread, wheat, rice flakes, puffed rice, barley, biscuits, popcorn) (1)			
White roots and tubers (white potatoes, turnips) (2)			
Vitamin A rich vegetables and tubers (pumpkin, carrots, squash, orange-flesh sweet potatoes) (3)			
Dark leafy green vegetables (amaranth, spinach, taro leaf, pumpkin leaf, jute leaf) (4)			
Other vegetables (cucumber, radish, pepper, cabbage, beans, cauliflower, onion) (5)			
Vitamin A rich fruits (ripe papaya, ripe mango, orange, grapefruit) (6)			
Other fruits (banana, apple, jackfruit, watermelon, guava, plums, pineapple, melons, lemons, lychees) (7)			
Meat (chicken, beef, poultry, lamb, liver, kidney) (8)			
Eggs (9)			
Fish and seafood (10)			
Legumes, nuts, and seeds (lentils, dal, black gram, kheshari, mung beans) (11)			
Milk and milk products (cow milk, goat milk, powdered milk, yogurt,			

curd, cheese) (12) Oils and fats (butter, ghee, mustard oil, soybean oil) (13) Sweets (sugar, honey, molasses, chocolate, ice cream, soda) (14) Spices, condiments, beverages (black pepper, salt, fish powder, soy sauce, chili sauce, cumin, chili powder, cinnamon, coffee, tea) (15)			

Q122 I am going to ask you some questions about nutrition, vitamins and food. This is a survey, not a test. Your answers will help identify which dietary advice people find confusing. Please let me know if you need me to clarify any of my questions. Feel free to ask me any questions you may have. If you do not know the answer, it is ok to respond "I don't know."

Q123 Do you think that health experts recommend that people should be eating more, the same amount, or less of these foods? (Mark one box per food)

	More (1)	Same (2)	Less (3)	I don't know (4)
Vegetables (1)	❍	❍	❍	❍
Sweets (2)	❍	❍	❍	❍
Meat (3)	❍	❍	❍	❍
Carbohydrates (4)	❍	❍	❍	❍
Fatty foods (5)	❍	❍	❍	❍
High fibre foods (6)	❍	❍	❍	❍
Fruit (7)	❍	❍	❍	❍
Salty foods (8)	❍	❍	❍	❍

Q124 How many servings of fruits and vegetables per day do you think experts are advising people to eat? (One serving could be, for example, an apple or a spoonful of cucumbers). The response should be in number of times per day/servings, not grams.

Q125 Experts classify food into groups. We are interested to see whether people are aware of what foods are in these groups.

Q126 Do you think the following foods are high or low in vitamin A?

	High (1)	Low (2)	Unsure (3)
Carrot (1)	❍	❍	❍
Banana (27)	❍	❍	❍
Rice (28)	❍	❍	❍
Wheat flour (47)	❍	❍	❍
Mola fish (49)	❍	❍	❍
Leafy greens (spinach, amaranth) (50)	❍	❍	❍

Q127 Do you think experts put these foods in the carbohydrates group?

	Yes (1)	No (2)	Unsure (3)
Rice (1)	❍	❍	❍
Potatoes (3)	❍	❍	❍
Sweet potatoes (4)	❍	❍	❍
Chapati (5)	❍	❍	❍
Biscuits (6)	❍	❍	❍

Q128 Do you think these foods are high or low in protein?

	High (1)	Low (2)	Unsure (3)
Chicken (1)	❍	❍	❍
Fish (2)	❍	❍	❍
Egg (3)	❍	❍	❍
Pulses (4)	❍	❍	❍
Milk (5)	❍	❍	❍
Fruit (6)	❍	❍	❍
Rice (7)	❍	❍	❍

Q129 Are you aware of any major health problems or diseases that are related to a low intake of fruits and vegetables?

❍ Yes (1)
❍ No (2)
❍ Unsure (3)

Answer If Are you aware of any major health problems or diseases that are related to a low intake of fruits and vegetables? Yes Is Selected

Q130 What diseases or health problems do you think are related to a low intake of fruits and vegetables?

Q131 Are you aware of any major health problems or diseases that are related to how much sugar people eat?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Q132 What diseases or health problems do you think are related to sugar?

Q133 Are you aware of any major health problems or diseases that are related to the amount of fat people eat?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

Q134 What diseases or health problems do you think are related to fat?

Q135 Now I am going to ask you some questions about nutrition for pregnant and lactating women. Please let me know if you need me to clarify any of my questions. Feel free to ask me any questions you may have. If you do not know the answer, it is ok to respond "I don't know."

Q136 How should a pregnant woman eat in comparison to a non-pregnant woman to provide good nutrition to her baby to help him or her grow? Please list 4 practices she should do. Mark only the answers that the respondent names. Do not read these choices to the respondent.

- ❑ Eat more food / more energy (1)
- ❑ Eat more protein-rich foods (2)
- ❑ Eat more iron-rich foods (3)
- ❑ Use iodized salt when preparing meals (4)
- ❑ Other (5) _____
- ❑ I don't know (6)

Q137 Are there common supplements, or tablets, recommended to women during pregnancy? If so, can you name them? Mark only the answers that the respondent names. Do not read these choices to the respondent.

- ❑ Iron supplements (1)
- ❑ Folic acid supplements (2)
- ❑ None (5)
- ❑ Other (3)
- ❑ I don't know (4)

Q138 How should a lactating woman eat in comparison with a non-lactating woman to be healthy and produce more breastmilk? Mark only the answers that the respondent names. Do not read these choices to the respondent.

- ❑ Eat more food / more energy (1)
- ❑ Eat more protein-rich foods (2)
- ❑ Eat more iron-rich foods (3)
- ❑ Use iodized salt when preparing meals (4)
- ❑ Other (5)
- ❑ I don't know (6)

Q139 Now I have some questions about breastfeeding practices and infant and child nutrition. Please let me know if you need me to clarify any of my questions. Feel free to ask me any questions you may have. If you do not know the answer, it is ok to respond "I don't know."

Q140 How long should a baby receive nothing but breastmilk?Probe if necessary: Until what age is it recommended that a mother feeds nothing more than breastmilk?

- ❍ From birth to 6 months (1)
- ❍ From birth to 11 months (2)
- ❍ Other (3)
- ❍ I don't know (4)

Q141 How long is it recommended that a woman breastfeeds her child?Probe if necessary: Until what age is it recommended that a mother continues breastfeeding?

- ❑ Six months or less (1)
- ❑ 6-11 months (2)
- ❑ 12-24 months (3)
- ❑ More than 24 months (4)
- ❑ Other (5)
- ❑ I don't know (6)

Q326 The following questions refer to the BAUEC/Sushilan event you attended and the nutrition training session. Your answers will be kept confidential and will not affect your participation in future events or programs.

Q327 How would you rate the information presented in the nutrition training "What goes on the plate"? (1 is not helpful at all, 5 is very helpful)

- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ N/A (6)

Q328 How likely are you to share the information from the nutrition training "What goes on the plate" with other individuals (family members, friends, etc.)? (1 is not at all likely, 5 is very likely)

- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ N/A (6)

Q410 With whom are you most likely to share the nutrition training "What goes on the plate" information?

- ❑ Spouse (1)
- ❑ Parents or in-laws (2)
- ❑ Children (3)
- ❑ Other family members (5)
- ❑ Friends - female (6)
- ❑ Friends - male (7)
- ❑ Other (8) _____
- ❑ No one (9)
- ❑ I did not receive nutrition training. (10)

Q329 Please rank the facilitators of the nutrition training. (1 is poor, 5 is excellent)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ N/A (6)

Q411 How would you rate the information presented in the gender training "Who gets what to eat"? (1 is not helpful at all, 5 is very helpful)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ N/A (6)

Q412 How likely are you to share the information from the gender training "Who gets what to eat" with other individuals (family members, friends, etc.)? (1 is not at all likely, 5 is very likely)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ N/A (6)

Q413 With whom are you most likely to share the information from the gender training "Who gets what to eat" information?
- ❑ Spouse (1)
- ❑ Parents or in-laws (2)
- ❑ Children (3)
- ❑ Other family members (5)
- ❑ Friends - female (6)
- ❑ Friends - male (7)
- ❑ Other (8) _____
- ❑ No one (9)
- ❑ I did not receive nutrition training. (10)

Q414 Please rank the facilitators of the gender training. (1 is poor, 5 is excellent)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ N/A (6)

Q330 Please rank the quality of the lunch buffet meal at the event. (1 is poor, 5 is excellent)
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)

Q331 Did you like the food at the event?
- ❍ Yes (1)
- ❍ No (2)

Q332 Show the plate to the participant and say "Now I would like to ask you some questions about this FHI360 SHIKHA food plate."

Q415 At the BAUEC/Sushilan event, did you receive the FHI360 SHIKHA food plate to take home?
- ❍ Yes (1)
- ❍ No (2)

Answer If At the BAUEC/Sushilan event, did you receive this plate to take home? Yes Is Selected

Q333 Did you receive enough partitioned plates for each member of your household?
- ❍ Yes (1)
- ❍ No (2)

Q425 Do you still have all of the FHI360 SHIKHA food plates you were given?
- ❍ Yes (1)
- ❍ I have some but I gave one or more away to someone else (2)
- ❍ I have some but I disposed of one or more plate (3)
- ❍ I no longer have any SHIKHA plates because I gave them all away (6)
- ❍ I no longer have any SHIKHA plates because I disposed of them (7)
- ❍ I did not receive any SHIKHA plates (8)

Q468 How often do you use the FHI360 SHIKHA food plate to eat your meals?
- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ I did not receive any SHIKHA plates (5)

Q335 How often do you refer to the plate to make decisions on the type of food to prepare?
- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ I did not receive any SHIKHA plates (5)

Q437 How often do you refer to the plate to make decisions on the type of food to consume?
- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ I did not receive any SHIKHA plates (5)

Q336 How often do you refer to the plate to make decisions on the amount of food to serve others?
- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ I did not receive any SHIKHA plates (5)

Q432 How often do you refer to the plate to make your own decisions about the amount of food to consume?
- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ I did not receive any SHIKHA plates (5)

Q334 In the last 7 days, have you used this FHI360 SHIKHA food plate during a meal eaten during the day or at night?
- ❍ Yes (1)
- ❍ No (2)

Answer If In the last 7 days, have you used this FHI360 SHIKHA food plate during a meal eaten during the day or at night? Yes Is Selected

Q424 How many times have you used the plate during a meal in the last 7 days?

Q469 Why do you not use/refer to the FHI360 SHIKHA food plate?

- ❑ I prefer other to use plates during my meal (1)
- ❑ I do not have access to the food items displayed on the plate (2)
- ❑ I do not understand the plate message (3)
- ❑ I cannot afford the food items displayed on the plate (4)
- ❑ Other (5)
- ❑ N/A (8)

Answer If Why do you not use the FHI360 SHIKHA food plate? Other Is Selected

Q470 Describe "other" reason why you do not use the FHI360 SHIKHA food plate.

Answer If Why do you not use the FHI360 SHIKHA food plate? I do not have access to the food items displayed on the plate Is Selected

Q471 What type of food items on the FHI360 SHIKHA food plate do you not have access to?

- ❑ Meat (1)
- ❑ Fish (2)
- ❑ Vegetables (3)
- ❑ Rice (4)
- ❑ Dal (5)

Answer If Why do you not use the FHI360 SHIKHA food plate? I cannot afford the food items displayed on the plate Is Selected

Q472 What type of food items on the FHI360 SHIKHA food plate are not affordable for you?

- ❑ Meat (1)
- ❑ Fish (2)
- ❑ Vegetables (3)
- ❑ Rice (4)
- ❑ Dal (5)

Q339 In the last 7 days, how many people in your household, other than yourself, have used the FHI360 SHIKHA food plate?

Q356 How many people did you talk to about the BAUEC/Sushilan event, the nutrition or gender training, or about the FHI360 SHIKHA food plate?

Q343 I would like to ask more information about the individuals in your household who are using the plate.

Answer If In the last 7 days, has anyone used the partitioned plate during a meal eaten during the day or at night? Yes Is Selected

Q341 Who has used the plate?
First name (1)

Q427 Gender of ${q://QID366/ChoiceTextEntryValue/1}
- ❍ Male (1)
- ❍ Female (2)

Q428 What is ${q://QID366/ChoiceTextEntryValue/1}'s age?

Q426 What is ${q://QID366/ChoiceTextEntryValue/1}'s relationship to the head of household?

- ❍ Head of household (19)
- ❍ Wife of head of household (41)
- ❍ Husband of head of household (40)
- ❍ Mother in law (20)
- ❍ Father in law (21)
- ❍ Cousin -Female (3)
- ❍ Cousin -Male (4)
- ❍ Aunt (5)
- ❍ Uncle (6)
- ❍ Grandfather (7)
- ❍ Grandmother (8)
- ❍ Father (9)
- ❍ Mother (10)
- ❍ Daughter (11)
- ❍ Son (12)
- ❍ Granddaughter (13)
- ❍ Grandson (14)
- ❍ Sister (15)
- ❍ Brother (16)
- ❍ Niece (17)
- ❍ Nephew (18)

Q416 How many times in the last 7 days has ${q://QID366/ChoiceTextEntryValue/1} used the FHI360 SHIKHA food plate during a meal?

Q429 How did ${q://QID366/ChoiceTextEntryValue/1} use the FHI360 SHIKHA food plate during the meal(s) in the last 7 days? (Select all that apply)
- ❑ Ate a meal using the plate (2)
- ❑ Referred to the SHIKHA plate to make decisions about what food to prepare (1)
- ❑ Referred to the SHIKHA plate to make decisions about what type of food to consume (7)
- ❑ Referred to the SHIKHA plate to make decisions about how much food to serve others (3)
- ❑ Referred to the SHIKHA plate to make own decisions about how much food to consume (4)
- ❑ Other (5)
- ❑ Unsure (6)

Answer If How has${q://QID366/ChoiceTextEntryValue/1} used the FHI360 SHIKHA food plate? Other Is Selected

Q430 Specify how this person has used the plate if "other" is selected.

Q433 How often does ${q://QID366/ChoiceTextEntryValue/1} refer to the plate to make decisions on the type of food to prepare?

- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ Unsure (6)

Q436 How often does ${q://QID366/ChoiceTextEntryValue/1} refer to the plate to make decisions on the type of food to consume?

- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ Unsure (7)

Q434 How often does ${q://QID366/ChoiceTextEntryValue/1} refer to the plate to make decisions on the amount of food to serve others?

- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ Unsure (6)

Q435 How often does ${q://QID366/ChoiceTextEntryValue/1} refer to the plate to make his/her own decisions about how much food to consume?

- ❍ Never (1)
- ❍ Rarely (4)
- ❍ Sometimes (3-4 times in last 4 weeks) (2)
- ❍ Often (More than 10 times in last 4 weeks) (3)
- ❍ Unsure (7)

Q438 Now I would like to ask you some questions about the people you talked to about the training or food plate.

Q347 What is the name of the person who you talked to about the FHI360 SHIKHA food plate?

Father/Husband's Name (1)

Given/First Name (2)

Q417 Gender of the person you talked to
- ❍ Male (1)
- ❍ Female (2)

Q351 What district does he/she live in?
- ❍ Mymensingh (1)
- ❍ Borguna (2)
- ❍ Other (3)

Answer If What district does he/she live in? Other Is Selected

Q421 Specify district and village this person lives in.

District (1)

Village (2)

Answer If What district does he/she live in? Borguna Is Selected

Q352 Sushilan Village
- ❍ Baitakata (1)
- ❍ Baitmore (2)
- ❍ Chalavanga (3)
- ❍ Chandra (4)
- ❍ Chandra Kapali (5)
- ❍ Ghathkhali (6)
- ❍ Gilatali (7)
- ❍ Holdia (8)
- ❍ Holodia (Paka) (9)
- ❍ Holodia (10)
- ❍ Kalibari (11)
- ❍ Kawnia (12)
- ❍ Kawnia Kapali (13)
- ❍ Loda (14)
- ❍ Patakata (15)
- ❍ Patakata midle (16)
- ❍ Uttar Tokta Bunia (17)
- ❍ Other (18)

Answer If Sushilan Village Other Is Selected

Q418 Specify name of village if "other" is selected

Answer If What district does he/she live in? Mymensingh Is Selected

Q353 BAU Village

- ❍ Boira moddapara sorkar bari (1)
- ❍ Boira Mosque (2)
- ❍ borobilarpar (3)
- ❍ Bot tola bazar (4)
- ❍ Bot tola hatem bapari (5)
- ❍ Chor nilokkhai ujanpara (6)
- ❍ Chorkalibari shomvuganj (7)
- ❍ Chornillokhia digolpara (8)
- ❍ Goneshampur (9)
- ❍ Gosta north (10)
- ❍ Jhaugau (11)
- ❍ Jogir ali chor nilokkhia (12)
- ❍ Kismat khagdohor (13)
- ❍ Maijbari (14)
- ❍ Mirjapur east (15)
- ❍ Mirjapur north (16)
- ❍ Mirjapur south (17)
- ❍ Muktijodda bazar chor (18)
- ❍ Mukhtijoddha bazar jogir algi (19)
- ❍ Pagla Bazaar (20)
- ❍ Pagla bazar kazi bari (21)
- ❍ Pagla bazar mojiborer bari (22)
- ❍ Ragobpur (23)
- ❍ Sathiapara (24)
- ❍ Sathiapra chor nillokkhia (25)
- ❍ Shailmari purrush (26)
- ❍ Suhila moddopara (27)
- ❍ Suhila nodir par (28)
- ❍ Suhila north (29)
- ❍ Sutiakhali middle (30)
- ❍ Sutiakhali palpara 1 (31)
- ❍ Sutiakhali palpara 2 (32)
- ❍ Vabokhali west (33)
- ❍ Vabukhali (34)
- ❍ Other (35)

Answer If BAU Village Other Is Selected

Q419 Specify name of village if "other" is selected.

Q355 What is this person's relationship to you:

- ❍ Friend -Female (1)
- ❍ Friend -Male (2)
- ❍ Coworker - Female (38)
- ❍ Coworker - Male (39)
- ❍ Acquaintance - Female (40)
- ❍ Acquaintance - Male (41)
- ❍ Spouse (19)
- ❍ Mother in law (20)
- ❍ Father in law (21)
- ❍ Cousin -Female (3)
- ❍ Cousin -Male (4)
- ❍ Aunt (5)
- ❍ Uncle (6)
- ❍ Grandfather (7)
- ❍ Grandmother (8)
- ❍ Father (9)
- ❍ Mother (10)
- ❍ Daughter (11)
- ❍ Son (12)
- ❍ Granddaughter (13)
- ❍ Grandson (14)
- ❍ Sister (15)
- ❍ Brother (16)
- ❍ Niece (17)
- ❍ Nephew (18)

Q357 What did you tell this person?

- ❍ I told them I went to a training (1)
- ❍ I told them about the training and shared what I learned with them (2)
- ❍ I showed them the plate (3)
- ❍ I told them about the training, I shared what I learned, and I showed them the plate (4)
- ❍ Other (5)

Answer If What did you tell this person? Other Is Selected

Q420 Specify what you told this person if "other" is selected.

Q337 Prior to the BAUEC/Sushilan event had you or anyone in your household seen the FHI360 SHIKHA project food plate?

- ❍ Yes (1)
- ❍ No (2)

Answer If Prior to the event had you or anyone in your household seen the FHI360 Shika project food plate? Yes Is Selected

Q338 Where did you or your family member first see the FHI360 SHIKHA food plate? (Name of NGO or government institution, and briefly describe the setting)

Q58 Did your household produce any cereal crops in the last year? (Mark all that apply)
- ❑ Rice (Aus, Aman, and/or Boro) (1)
- ❑ Maize (2)
- ❑ Wheat (3)
- ❑ Other (4) _____
- ❑ Other (5) _____
- ❑ No cereal (6)

Q59 Count the number of cereal crops produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (6)
- ❍ 2 (7)
- ❍ 3 (8)
- ❍ 4 (9)
- ❍ 5 (10)

Q60 Type of cereal

Q61 What was the total area planted for ${q://QID155/ChoiceTextEntryValue/1} in the last year? (Decimals)

Q62 How much ${q://QID155/ChoiceTextEntryValue/1} did you produce in the last year?

Q63 Units of production
- ❍ Kilograms (2)
- ❍ Other (3) _____

Q64 How much ${q://QID155/ChoiceTextEntryValue/1} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q458 Price received for sale of ${q://QID155/ChoiceTextEntryValue/1} (BDT per unit)

Q65 Did your household produce any vegetables in the last year? (Mark all that apply)

- ❑ Pumpkin (1)
- ❑ Bitter gourd (2)
- ❑ Bottle gourd (3)
- ❑ Eggplant (21)
- ❑ White potato (4)
- ❑ Sweet potato (orange) (5)
- ❑ Tomato (6)
- ❑ Cucumber (7)
- ❑ Red amaranth (8)
- ❑ Amaranth (9)
- ❑ Spinach (10)
- ❑ Cauliflower (11)
- ❑ Cabbage (12)
- ❑ Okra (13)
- ❑ Chili pepper (14)
- ❑ Onion (15)
- ❑ Turnips (16)
- ❑ Taro (17)
- ❑ Other (18) _____
- ❑ Other (19) _____
- ❑ No vegetables (20)

Q66 Count the number of vegetable crops produced in the last year and confirm with the respondent.

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10 (11)
- ❍ 11 (12)
- ❍ 12 (13)
- ❍ 13 (14)
- ❍ 14 (15)
- ❍ 15 (16)
- ❍ 16 (17)
- ❍ 17 (18)
- ❍ 18 (19)
- ❍ 19 (20)

Q67 Type of vegetable

Q68 Is this vegetable mixed crop with other vegetables?

- ❍ Yes (1)
- ❍ No (2)

Answer If Is this vegetable mixed crop with other vegetables? Yes Is Selected

Q69 In your mixed crop plot of land, is ${q://QID163/ChoiceTextEntryValue} more or less than half of the area planted?

- ❍ More than half (1)
- ❍ About half (2)
- ❍ Less than half (3)

Q70 What was the total area planted for ${q://QID163/ChoiceTextEntryValue/2} in the last year? (Decimals)Note: If the vegetable is mixed crop, calculate and enter the approximate number of decimals allocated to this crop based on the previous question and the total land used for vegetables.

Q71 How much ${q://QID163/ChoiceTextEntryValue/2} did you produce in the last year?

Q72 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q73 How much ${q://QID163/ChoiceTextEntryValue/2} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q459 Price received for sale of ${q://QID163/ChoiceTextEntryValue/2} (BDT per unit)

Q74 Did your household produce any pulses in the last year? (Mark all that apply)
- ❑ Lentils (1)
- ❑ Mung bean (2)
- ❑ Khesari (3)
- ❑ Other pulses (4) _____
- ❑ Other pulses (5) _____
- ❑ No pulses (6)

Q75 Count the number of pulses produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)

Q76 Type of pulse

Q77 What was the total area planted for ${q://QID221/ChoiceTextEntryValue/2} in the last year? (Decimals)

Q78 How much ${q://QID221/ChoiceTextEntryValue/2} did you produce in the last year?

Q79 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q80 How much ${q://QID221/ChoiceTextEntryValue/2} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q460 Price received for sale of ${q://QID221/ChoiceTextEntryValue/2} (BDT per unit)

Q81 Did your household produce any fruit in the last year? (Mark all that apply)
- ❑ Mango (1)
- ❑ Jujube (2)
- ❑ Jackfruit (3)
- ❑ Litchi (4)
- ❑ Guava (5)
- ❑ Papaya (6)
- ❑ Coconut (7)
- ❑ Banana (8)
- ❑ Other (9) _____
- ❑ Other (10) _____
- ❑ Other (11) _____
- ❑ No fruits (12)

Q82 Count the number of fruits produced in the last year and confirm with the respondent.
- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10 (11)
- ❍ 11 (12)

Q83 Type of fruit

Q84 How many ${q://QID231/ChoiceTextEntryValue} trees produced fruit in the last year?

Q85 How much ${q://QID231/ChoiceTextEntryValue} did you produce in the last year?

Q86 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q87 How much ${q://QID231/ChoiceTextEntryValue} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q461 Price received for sale of ${q://QID231/ChoiceTextEntryValue} (BDT per unit)

Q88 Did your household produce any oilseed crops in the last year? (Mark all that apply)
- ❑ Mustard (1)
- ❑ Peanut (2)
- ❑ Soybean (3)
- ❑ Sesame (4)
- ❑ Other (5) _____
- ❑ Other (6) _____
- ❑ Other (7) _____
- ❑ No oilseeds (8)

Q89 Count the number of oilseed crops produced in the last year and confirm with the respondent.

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)

Q90 Type of oilseed

Q91 What was the total area planted for ${q://QID239/ChoiceTextEntryValue} in the last year? (Decimals)

Q92 How much ${q://QID239/ChoiceTextEntryValue} did you produce in the last year?

Q93 Units of production

- ❍ Kilograms (2)

Q94 How much ${q://QID239/ChoiceTextEntryValue} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q462 Price received for sale of ${q://QID239/ChoiceTextEntryValue} (BDT per unit)

Q95 Did your household produce any fibrous crops in the last year? (Mark all that apply)

- ❑ Jute (1)
- ❑ Kenaf (8)
- ❑ Mesta (2)
- ❑ Other (5) _____
- ❑ Other (6) _____
- ❑ Other (7) _____
- ❑ No fibrous crops (13)

Q96 Count the number of fibrous crops produced in the last year and confirm with the respondent.

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)

Q97 Type of fibrous crop

Q98 What was the total area planted for ${q://QID247/ChoiceTextEntryValue} in the last year? (Decimals)

Q99 How much ${q://QID247/ChoiceTextEntryValue} did you produce in the last year?

Q100 Units of production

- ❍ Kilograms (2)

Q101 How much ${q://QID247/ChoiceTextEntryValue} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Paid to land owner (3)	Sold (1)	Kept for home consumption (2)
Product (1)			

Q463 Price received for sale of ${q://QID247/ChoiceTextEntryValue} (BDT per unit)

Q102 Did your household raise any livestock for production in the last year? If yes, what animal products did you produce? (Mark all that apply)

- ❑ Cow milk (1)
- ❑ Cow meat (beef) (13)
- ❑ Chicken meat (5)
- ❑ Chicken eggs (14)
- ❑ Duck meat (15)
- ❑ Duck eggs (6)
- ❑ Goat milk (7)
- ❑ Goat meat (8)
- ❑ Pigeon meat (9)
- ❑ Other (10) _____
- ❑ Other (4) _____
- ❑ Other (11) _____
- ❑ No livestock (12)

Q103 Count the number of animal products the household produced in the last year and confirm with the respondent.

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)

Q104 Type of animal product Note: Be specific about animal type. If milk, specify cow or goat. If eggs, specify chicken or duck.

Animal product (1)

Q105 How many animals did you have for producing ${q://QID169/ChoiceTextEntryValue/1} in the last year?

Q106 How much ${q://QID169/ChoiceTextEntryValue/1} did you produce in the last year?

Q107 Units of production

- ❍ Kilograms (1)
- ❍ Liters (2)
- ❍ Pieces (3)

Q108 How much ${q://QID169/ChoiceTextEntryValue/1} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given above for total production.

	Sold (1)	Kept for home consumption (2)
Product (1)		

Q464 Price received for sale of ${q://QID169/ChoiceTextEntryValue/1}(BDT per unit)

Q109 Did your household cultivate any fish last year? (Mark all that apply)

- ❑ Rui (23)
- ❑ Katla (25)
- ❑ Carp (26)
- ❑ Tilapia (27)
- ❑ Koi (28)
- ❑ Mola (29)
- ❑ Shrimp (30)
- ❑ Prawn (31)
- ❑ Other (32) _____
- ❑ Other (33) _____
- ❑ Other (34) _____
- ❑ No fish (24)

Q110 Count the number of fish species cultivated in the last year and confirm with the respondent.

- ❍ 0 (1)
- ❍ 1 (2)
- ❍ 2 (3)
- ❍ 3 (4)
- ❍ 4 (5)
- ❍ 5 (6)
- ❍ 6 (7)
- ❍ 7 (8)
- ❍ 8 (9)
- ❍ 9 (10)
- ❍ 10 (11)
- ❍ 11 (12)

Q111 Type of fish

Species (1)

Q441 How many fish ponds do you use to cultivate ${q://QID187/ChoiceTextEntryValue/1}?

Q443 What is the total land area of the fish ponds used to cultivate ${q://QID187/ChoiceTextEntryValue/1}?

Q442 Is this pond used for polyculture? (Many species in one pond)
- ❍ Yes (1)
- ❍ No (2)

Q112 How much ${q://QID187/ChoiceTextEntryValue/1} did you produce in the last year?

Q113 Units of production
- ❍ Kilograms (2)
- ❍ Pieces (3)

Q114 How much ${q://QID187/ChoiceTextEntryValue/1} did you sell and how much did you keep for home consumption? Note: Verify that the total does not exceed the answer given in the previous question about total production.

	Sold (1)	Kept for home consumption (2)
Product (1)		

Q465 Price received for sale of ${q://QID187/ChoiceTextEntryValue/1}(BDT per unit)

Q142 Now I have some questions for you about food purchases and agriculture markets.

Q143 Are you the person who makes the final decision about food purchases and preparation?
- ❍ Yes (1)
- ❍ No (2)

Answer If Are you the person who makes the final decision about food purchases and preparation? No Is Selected

Q144 Who makes the final decision regarding food purchases and preparation?

- ❍ Head of household (1)
- ❍ Wife of household head (2)
- ❍ Husband of household head (3)
- ❍ Son (4)
- ❍ Daughter (5)
- ❍ Father (6)
- ❍ Mother (7)
- ❍ Daughter-in-law (8)
- ❍ Son-in-law (9)
- ❍ Brother (10)
- ❍ Sister (11)
- ❍ Father-in-law/Mother-in-law (12)
- ❍ Nephew/Niece (13)
- ❍ Grandfather/Grandmother (14)
- ❍ Sister-in-law/Brother-in-law (15)
- ❍ Brother's wife (16)
- ❍ Other (e.g. servant) (17)

Q145 If you had more income, would you spend more of your money on food?

- ❍ Yes (1)
- ❍ No (2)

Q146 If you had more money available to spend on food would you consume the same types of food?

- ❍ Yes (1)
- ❍ No (2)

Q147 If you had more money available to spend on food, which of the following would you consume more of? (Mark all that apply)

- ❑ Cereals (1)
- ❑ Pulses (2)
- ❑ Vegetables (3)
- ❑ Fruits (4)
- ❑ Meat (5)
- ❑ Eggs (6)
- ❑ Fish (7)
- ❑ Milk or milk products (8)
- ❑ Sweets (9)
- ❑ Other foods (10) _____
- ❑ I would not spend more money on food. (11)

Q148 Did anyone in your household buy any food (from a market) to cook in the household in the last year?

- ❍ Yes (1)
- ❍ No (2)

Answer If Did anyone in your household buy any food (from a market) to cook in the household in the last year? Yes Is Selected

Q149 How long does it take to walk to a place to buy food?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)

Answer If Did anyone in your household buy any food (from a market) to cook in the household in the last year? Yes Is Selected

Q150 What mode of transportation does your household use to go to the market for buying food?

- ❍ By foot (1)
- ❍ By bicycle (2)
- ❍ By rickshaw/van (3)
- ❍ By car/truck (4)
- ❍ By motorcycle (5)
- ❍ By boat (6)
- ❍ Other (7) _____

Answer If Did anyone in your household buy any food (from a market) to cook in the household in the last ye... Yes Is Selected

Q151 How much does this transportation cost per trip to the market? (BDT)

Q152 Does anyone in your household ever sell commercial agricultural products grown in your household (e.g. rice, maize)?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell commercial agricultural products grown in your household (e.g. rice, maize)? Yes Is Selected

Q153 How long does it take to walk to the place to sell commercial agricultural products, for example to a market or buyer pick-up location?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell commercial agricultural products grown in your household... Yes Is Selected

Q154 Who controls the income from sales of commercial agricultural products? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q155 Does anyone in your household ever sell vegetables or fruits grown in your household? (e.g. pumpkins, cucumbers, mangos)

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell vegetables or fruits grown in your household? (e.g. pumpkins, cucumbers, mangos) Yes Is Selected

Q156 How long does it take to walk to the place to sell vegetables or fruits?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell vegetables or fruits grown in your household? (e.g. pumpk... Yes Is Selected

Q157 Who controls the income from the sales of vegetables/fruits? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q158 Does anyone in your household ever sell fish produced in your household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell fish produced in your household? Yes Is Selected

Q159 How long does it take to walk to the place to sell fish?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell fish produced in your household? Yes Is Selected

Q440 Who controls the income from the sale of fish? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q160 Does anyone in your household ever sell animal protein (meat) produced in your household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell animal protein (meat) produced in your household? Yes Is Selected

Q161 How long does it take to walk to the place to sell animal protein (meat)?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell animal protein (meat) produced in your household? Yes Is Selected

Q162 Who controls the income from the animal protein (meat)? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17)

Q163 Does anyone in your household ever sell eggs produced in your household?

- ❍ Yes (1)
- ❍ No (3)

Answer If Does anyone in your household ever sell eggs produced in your household? Yes Is Selected

Q164 How long does it take to walk to the place to sell eggs?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell eggs produced in your household? Yes Is Selected

Q165 Who controls the income from the sale of eggs? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17) _____

Q166 Does anyone in your household ever sell milk or milk products produced in the household?

- ❍ Yes (1)
- ❍ No (2)

Answer If Does anyone in your household ever sell milk or milk products produced in the household? Yes Is Selected

Q167 How long does it take to walk to the place to sell milk or milk products?

- ❍ Less than 30 minutes (1)
- ❍ 30 minutes to 1 hour (2)
- ❍ 1 to 2 hours (3)
- ❍ More than 2 hours (4)
- ❍ Sell at the household (5)

Answer If Does anyone in your household ever sell milk or milk products produced in the household? Yes Is Selected

Q168 Who controls the income from the sale of milk or milk products? Mark all that apply.

- ❑ Head of household (1)
- ❑ Wife of household head (2)
- ❑ Husband of household head (3)
- ❑ Son (4)
- ❑ Daughter (5)
- ❑ Father (6)
- ❑ Mother (7)
- ❑ Daughter-in-law (8)
- ❑ Son-in-law (9)
- ❑ Brother (10)
- ❑ Sister (11)
- ❑ Father-in-law/Mother-in-law (12)
- ❑ Nephew/Niece (13)
- ❑ Grandfather/Grandmother (14)
- ❑ Sister-in-law/Brother-in-law (15)
- ❑ Brother's wife (16)
- ❑ Other (e.g. servant) (17) _____

Answer If Does anyone in your household ever sell commercial agricultural products grown in your household... Yes Is Selected Or Does anyone in your household ever sell vegetables or fruits grown in your household? (e.g. pumpk... Yes Is Selected Or Does anyone in your household ever sell fish produced in your household? Yes Is Selected Or Does anyone in your household ever sell animal protein (meat) produced in your household? Yes Is Selected Or Does anyone in your household ever sell milk or milk products produced in the household? Yes Is Selected Or Does anyone in your household ever sell eggs produced in your household? Yes Is Selected

Q169 What mode of transportation does your household use to transport agricultural goods, fish, or vegetables/fruits to the market/selling points?

- ❍ By foot (1)
- ❍ By bicycle (2)
- ❍ By rickshaw/van (3)
- ❍ By car/truck (4)
- ❍ By motorcycle (5)
- ❍ By boat (6)
- ❍ Other (7) _____

Q439 How much is the transportation cost per trip to the market to sell products? (BDT)

Q170 Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs?

- ❍ Yes (1)
- ❍ No (2)

Answer If Were there months, in the past 12 months, in which you did not have enough food to meet your family's needs? Yes Is Selected

Q171 During which months did you not have enough food to meet your family's needs? (Check all that apply)

- ❑ January (1)
- ❑ February (2)
- ❑ March (3)
- ❑ April (4)
- ❑ May (5)
- ❑ June (6)
- ❑ July (7)
- ❑ August (8)
- ❑ September (9)
- ❑ October (10)
- ❑ November (11)
- ❑ December (12)

Q172 In the past four weeks, did you worry that your household would not have enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you worry that your household would not have enough food? Yes Is Selected

Q173 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q174 In the past four weeks were you or any household member not able to eat the kinds of food you preferred because of a lack of resources to get food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks were you or any household member not able to eat the kinds of food you preferred because of a lack of resources to get food? Yes Is Selected

Q175 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q176 In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? Yes Is Selected

Q177 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q178 In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? Yes Is Selected

Q179 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q180 In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food? Yes Is Selected

Q181 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q182 In the past four weeks, was there ever no food of any kind in your household because of a lack of resources to get food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, was there ever no food of any kind in your household because of a lack of resources to get food? Yes Is Selected

Q183 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q184 In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food? Yes Is Selected

Q185 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q186 In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?

- ❍ Yes (1)
- ❍ No (2)

Answer If In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food? Yes Is Selected

Q187 How often did this happen?

- ❍ Rarely (1)
- ❍ Sometimes (3-4 times in the last 4 weeks) (2)
- ❍ Often (More than 10 times in the last 4 weeks) (3)

Q188 In the past 12 months, how often did you or any of your family have to eat potato, wheat, or another grain although you wanted to eat rice (not including when you were sick)?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q189 In the past 12 months, how often did you or any of your family skip entire meals due to scarcity of food?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q190 In the past 12 months, how often did you personally eat less food in a meal due to scarcity of food?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q191 In the past 12 months, how often did your family purchase food (rice, lentils, etc.) on credit or loan from a local shop?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

Q192 In the past 12 months, how often did your family have to borrow/take food from relatives or neighbors to make a meal?

- ❍ Never (1)
- ❍ Rarely (1-6 times in the last 12 months) (2)
- ❍ Sometimes (7-12 times in the last 12 months) (3)
- ❍ Often (a few times in each month) (4)
- ❍ Regularly (every day or almost every day) (5)

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BIOGRAPHICAL SKETCH

Kelly A. Davidson grew up on a grain and cattle farm in Nevada, Ohio and moved to Stamping Ground, Kentucky during high school. She completed her Bachelor of Science degree at the University of Kentucky in 2008, majoring in agricultural economics and foreign language–international economics, and minoring in French. As an undergraduate, Kelly studied abroad in France. She also conducted international fieldwork in the Republic of Georgia, collaborating on a project for higher education in agriculture. Furthermore, she served as a short-term consultant for the World Bank Commodity Risk Management Group and a research associate at GlobalAgRisk, Inc. Kelly received a Master of Science degree in agricultural economics at the University of Kentucky in 2009.

Kelly worked as a fisheries economist for the NOAA National Marine Fisheries Service, Pacific Islands Fisheries Science Center from 2009 to 2011. She developed an interest in aquaculture economics and served as faculty for the University of Hawai'i Aquaculture Training and Online Learning course on business and marketing. Inspired to pursue further teaching experience, Kelly returned to the mainland as a lecturer in agribusiness at the University of Tennessee at Martin. She taught a variety of courses in agribusiness, economics, and policy. Her enduring passion for agricultural economics and international development motivated her to return to graduate school.

Kelly began her doctoral studies in food and resource economics at the University of Florida in 2013. With support from the USAID Feed the Future initiative "Integrating Gender and Nutrition within Agricultural Extension Services" (INGENAES), Kelly traveled to Bangladesh to pilot the INGENAES technology assessment toolkit. Conversations with fish farmers and development agencies spurred her interest in nutrition initiatives for rural households. Specifically, she decided to measure the effectiveness of mechanisms that were

being used to promote nutrition. Inspired by the previous work of her advisor, Dr. Jaclyn Kropp, Kelly pursued this dissertation work, graciously funded by INGENAES.

After graduation, Kelly plans to continue her research on behavioral economics in food and agricultural policy. She is specifically interested in analyzing policies that impact low-income households, both domestically and internationally. She also hopes to inspire the next generation of agricultural economists through future research and teaching endeavors.